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Primary Care Workforce and Continuous Medical Education in China: Lessons to learn from a Nationwide Representative Survey

Short title: Workforce and continuous medical education in primary care in China

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Abstract

Objectives

This study aimed to examine the education and training background of Chinese community health centres' (CHC) staff, CME and factors affecting its participation.

Methods

A stratified random sample of CHCs based on geographical distribution and 2:1 urban-suburban ratio was selected covering three major regions of China. Two questionnaires, one for lead clinicians and another for frontline health professionals, were administered between September-December 2015, covering the demographics of clinic staff, staff training and CME activities.

Results

149 lead clinicians (response rate 79%) and, 1,734 doctors and 1,846 nurses completed the survey (response rate 86%). About half of the doctors had a bachelor degree or were registered as general practitioners (GPs) and 10% of them carried senior titles. Few nurses (5%) had training in primary care. About 90% of health professionals participated in CME. CME participation in doctors was more commonly reported by older, females, who registered as a GP or, with intermediate/senior job titles. CME participation in nurses was associated with holding a bachelor degree or, intermediate/senior job titles, or longer working experience in the CHC.

Conclusion

This representative survey confirms only half of doctors have bachelor degrees or are registered as GPs as their prime registration in the primary care workforce in China. The vast majority of CHC staff participated in CME but there is room for improvement in how CME is arranged.

Key words Continuous medical education, Training, Quality of care, Primary care, China

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Strengths and limitations

This study was the first study to survey the CME situation of a representative sample of medical staff in CHCs in mainland China. We focused on doctors and nurses working in CHCs, who are the core of the primary care workforce. Our study provides a useful baseline of the frequency and types of CME activities across a large number of CHCs. The main limitation of this study is that we focused on CME activities that were organised by CHCs but arguably those were the most commonly attended by the staff of individual CHCs. We did not evaluate the quality of CME being delivered or whether observable health improvements had resulted from CME participation. This could be the subject of future research through in-depth qualitative interviews of CHC staff and focused evaluations of CME programs in China.

Introduction

The importance of a strong primary care system based on first contact access and provision of person-focused comprehensive care with continuity and coordination, is widely accepted.[1-6] Despite a strong primary care system being repeatedly shown to be an effective approach at reducing health inequity and achieving universal health coverage,[2] many countries have yet to develop a robust primary healthcare system. Instead, primary care services are often characterized by inadequate resources and facilities, lack of appropriate training for their medical staff, variable quality in delivery of care and fragmented care.[7] In China, these problems were further compounded by economic and healthcare reforms in the 1980s which involved fiscal decentralization, commercialization of medical services, and underfunding of the public healthcare sector. These turned a generation of health professionals and the general public to rely heavily on high-tech diagnostics, expensive drugs and specialist procedures.[8,9] These factors reinforced unrealistic patient expectations focused on specialist diagnostic aids and procedures, while alienating cost-efficient primary care

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that would better suit the nation's health needs.[10]

In 2009, the Chinese government responded to these problems and committed themselves to re-establishing primary healthcare.[11] According to Health & Family Planning Commission, expenditure on primary care has reached USD17.74 billion (1USD=¥6.20) and accounted for approximately 30% of the public spending on health in 2014.[12] In fewer than ten years, the Chinese Government has succeeded in establishing a primary care infrastructure composed mainly of rural township centres, village clinics and community health centres (CHCs) in cities. By 2014, 8,669 CHCs had been established, employing over 300,000 health professionals. However, the historical image of 'barefoot doctors' who had worked in rural regions since the 1950s, criticism of the healthcare system by end-users, and negative publicity by the media have all led to a breakdown of trust between patients and health professionals, including in the newly-revamped primary care system.[9] This problem appears particularly pronounced in the cities where patients have greater choice and easier access to hospitals. One of the major problem is that CHC health professionals (doctors and nurses included) are regarded as poorly qualified and trained, and CHCs are poorly resourced, providing "low tech" facilities.[13]

In the past, medical courses were offered by a variety of colleges, vocational training schools and universities, ranging from 2-8 years of training. Graduates of these courses would have to sit and pass board examinations to be registered for their chosen specialties. Although shorter courses are still available to train the rural workforce, five-year undergraduate programs based at the university are now the norm to enter into vocational training. Nonetheless, general practice is a relatively new clinical discipline in China and there are currently few general practice departments in medical schools.[14] Hence, the exposure to general practice and primary

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care teaching at the undergraduate level is minimal and the discipline has a low status amongst other clinical disciplines.

At the vocational training level, the emphasis has been on implementing the new policy of establishing primary care in a very short time span through re-orientation of specialists to general practice, initially by "on-the-job training" and later replaced by "job-transfer" training, and training of new general practitioners (GPs) since 2011 with a three-year structured program with 2.5 years in hospital rotations followed by six months in the community. "Job-transfer training" is a one-year long programme aimed at the less qualified doctors currently working at CHCs or those who have not undergone "on-the-job training" to enhance their theoretical knowledge of general practice and practical clinical skills through a combination of lectures, hospital rotations and community-based placements.

Continuous medical education (CME) aimed at maintaining, developing and enhancing medical providers' professional knowledge, skills and interpersonal capacity to keep abreast of professional lives, is an essential element to maintain quality of care in this new system[15,16] and CME is compulsory for ongoing registration in China. According to the "Twelfth 5-year plan", [17] 100% of senior, 95% of mid-grade; and 80% of junior health professionals at provincial and city levels should achieve the required CME targets over two years. For staff working in western and peripheral regions of China, these targets were reduced to 95%, 80% and 70% respectively to reflect the phased development of primary care in these large and dispersed regions of the country. The hierarchy of the titles can only be achieved after passing the qualifying examination and fulfilling a number of stringent criteria including CME requirements, written examinations and publication of research manuscripts. This study aimed to evaluate the current organization and manpower of

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CHCs in China, as well as the training (especially the content and delivery of CME) of health professionals within primary care in China.

Methods

A nationwide representative survey using a stratified randomized sample was conducted amongst CHC medical professionals between September and December 2015. China was divided into three administrative regions: central, eastern and western. Two provinces were randomly selected from each region; and from these, the capital city and two district-level cities were selected at random. In addition, two of the four major municipalities (Beijing, Shanghai, Chongqing and Tianjin) were also selected at random and included in the sample. In total, twenty cities were chosen from the provinces and municipalities combined. From these, nine CHCs were randomly selected from each city (with an urban-to-suburban ratio of 2:1), giving a total of 180 CHCs. The lead clinicians and all doctors and nurses (excluding traditional Chinese herbalists) with direct patient contact from these selected CHCs were invited to participate in the survey.

The local chairpersons of the General Practitioner Associations of the six selected provinces and two selected municipalities were contacted, whom in turn, contacted the randomly selected CHCs. Training on how to distribute and complete the survey questionnaire was arranged for the coordinators of each province or municipality prior to the study. These coordinators were responsible for tracking and collecting the questionnaires. Collected data was entered and cleaned using EPIDATA 3.1. A data entry team was responsible for data input and appointed personnel for auditing and quality control.

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The study consisted of two questionnaires, one for the lead clinicians and another for CHC staff (i.e. doctors and nurses). The former (Appendix 1) covered current clinical set-up, range of services and staff composition, community characteristics and patient demographics; as well as information on CME organized at the clinic. In this survey we asked the lead clinician to use their own records to estimate the median population size of the catchment area and number of patient contacts in the past year. In the conditions, training experience, CME participation and their willingness to conduct certain testing services. CME organized by CHCs was compared with actual participation reported by the CHC staff. These surveys were pilot-tested twice on three CHCs and twenty-five practitioners with modifications made accordingly. Detailed methodology and, availability and use of primary care facilities is reported elsewhere .[18]

Descriptive analyses were conducted for percentages and frequencies of key parameters. Confidence intervals for the sample proportions were calculated using the Agresti-Coull (adjusted Wald) method. CME participation and content were broken down according to the three administrative districts which have different requirements for CME participation. Multivariable logistic regression was used to explore the staff characteristics as the independent factors (with odds ratios (OR) and 95% confidence intervals (CI) calculated) associated with participation of CME by the health professionals after adjusting for gender, medical specialty, years working in the CHC, job title and education level. All significance tests were two-tailed and those with a p-value less than 0.05 were considered statistically significant. Data were analyzed using STATA (StataCorp. 2013. *Stata Statistical Software: Release 13.* College Station, TX: StataCorp LP).

Results

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One hundred and forty-nine out of the 189 CHCs contacted provided data on their CHC (79% response rate). Figure 1 shows the distribution of CHCs surveyed in China. Of the 4,146 health professionals invited, 1,734 doctors and 1,846 nurses completed the survey giving a response rate of 86%.

The median population size of the catchment area of each CHC was 50,000 people (interquartile range (IQR) 30,000 to 96,000) with a migrant population of 11,100 (IQR 5,000-30,000). The median patient contacts per year was 41,100 (IQR 12,000 to 163,600). Table 1 provides the demographics of CHC staff. The median age of CHC doctors and nurses were young at 38 and 31 years of age, respectively. Women accounted for 61% of the doctors and nearly all the nurses, with a nurses-to-doctor ratio of 1.6. About half of the doctors had bachelor degrees or above, yet only 10% of them had acquired senior titles. Despite the fact that all were practising as GPs, only half of them were actually registered as general practitioners. Doctors and nurses had worked in general practice for a median of 14 years and 9 years, respectively.

Table 2 shows the range and frequency of reported on-site CME and CME participation. CME activities were held by nearly all CHCs (97.2%), nearly two-thirds (62.9%) holding CME sessions monthly or more frequently. According to the lead clinicians, all health professionals would have participated in CME, more frequently than managers (95%) and other health professionals (88%). However, when this figure was compared with the individual health professionals' survey, only about 90% of health professionals actually reported participating in CME. The type of in-house CME activities reported were diagnostic and treatment guidelines discussion (97.2%), management updates (84.8%) and case discussions (84.2%). Notably nurses reported much less involvement in these CME activities (57.3-64.1%).

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Table 3 shows CME participation for different types of health professionals in the three administrative districts. Despite CME participation being extremely high (ranging between 86% to 100%), those in the central and eastern regions fell short of the targets set by the State. In contrast to what was expected by the government, there was no significant difference of CME participation by GPs in the three administrative regions and CME participation was actually commoner among junior doctors in the western and peripheral regions compared to the central and eastern regions (p=0.039).

Table 4 summarizes the multivariate analysis of health professionals' characteristics with CME participation. Amongst doctors, CME participation was commoner among older doctors (adjusted odds ratios (aOR) 1.04 per year), women (aOR 1.7), those registered as GPs (aOR 3.0) and those with an intermediate or senior job title (aOR 2.2). Amongst nurses, CME participation was commoner among those with bachelor degrees (aOR 2.9), with longer experience working in general practice (aOR 1.1 per year) or with an intermediate or senior job title (aOR 2.2).

Discussion

This large representative study of China's CHCs examines the current primary care workforce and finds it is predominantly staffed by young female health professionals, with only half of doctors holding a bachelor degree or higher, or registered as a GP. The relatively low nurse-to-doctor ratio may reflect the focus of care where doctor-centred approach in the traditional medical model is preferred. The ratio was far from the international standard of approximately three nurses per doctors as recommended by World Health Organization (WHO).[19] Evidence exists that an undersupply of nurses could result in inefficient allocation of resources.[20]

For historical reason, many practicing health professionals at CHCs do not have a

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bachelor degree. Indeed, our study shows just over half of the doctors and under a third of the nurses working in primary care have a bachelor degree. This may contribute in part to the perception of poor training and poor quality in primary care. The quality of health care should be based upon the quality of the workforce rather than just increasing the sheer quantity of staff as it has been the focus of China's policy on development of primary care thus far. The education level and title seniority through examination are considered important indictors of professional standards and competency. Nurses who have a higher level of education provide better health care and safety for their patients.[21]

In China, due to the short history of primary care development, many senior doctors were previously either public health physicians or specialist who converted to being GPs and were given the task of setting up CHCs. Previously "on-the-job" and now "job-transfer" training is offered to the specialists who have converted to work as GPs before sitting the qualifying examination. In order to attract them to primary care, they are allowed to keep up to three specialties on their registration but in our survey, only 47% of the doctors chose to register general practice as their prime registration. Again we confirm that the CME participation rates for those registered as GPs are higher than those still registered as a specialist. Further, 97% of staff members with intermediate and senior level job titles participated in CME, which accounted for 39% of all CHC health professionals (52% of GPs and 29% of nurses). An advancement in job titles may provide a sense of ownership and autonomy,[9] and thus was identified as an independent factor in the participation of CME in our study.

CME is a requirement for practicing professionals in many countries including China in order to maintain medical knowledge and skills.[22] Doctors who do not participate in CME have lower confidence when making clinical decisions.[21] Although it is

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encouraging to see nearly all CHC staff had participated in CME, one-third of CHCs organize on-site CME activities once every quarter or even once a year, which is far from satisfactory. A Cochrane review suggests that CME should be accessible within health professionals' own clinical communities.[23] Other forms of CME might include attending professional conferences, research workshops or distance learning courses so long as they have been approved by the postgraduate center in their respective city. Learning objectives must be tailored beyond meeting the staff's CME requirements where each CHC or jointly in a locality should take into account the local context and needs e.g. the local disease pattern and epidemiology, and to provide the necessary training and support to their staff to address the skill-mix to deliver the service.

In China, both doctors and nurses have to fulfil at least 25 credits of approved CME every year and are reaccredited every two years. Arguably, reflective learning, meeting self-defined learning objectives and auditing clinical performance with practitioners expected to demonstrate certain competencies in managing the patients independently, would be more appropriate in quality improvement rather than time-based training.[21] Lack of time and appropriate resources have been reported as obstacles for CME participation in China.[24] Alternatives such as self-directed searches in the medical literature or medical websites, or structured resources on the internet (e.g. BMJ learning) or medical journals, exist to meet their learning needs.[25,26] Nonetheless these alternatives are limited by the motivation and skills required to perform these searches effectively as well as the availability and accessibility (including the language barrier) of these resources.

Our study suggests that 97.2% of CHCs hold discussions and learning sessions about treatment protocols and 84.8% on disease updates. If used well, evidence-based medicine can aid health professionals in making the most appropriate therapeutic decisions for individual patients and conditions at the clinical level. However, rapid advancements in therapeutic methods and multiple guidelines from both local and

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international agencies have made it difficult for health professionals to follow them closely. Primary healthcare staff can learn and incorporate these new updates and guidelines into their clinical practices only when they engage in the dissemination and implementation at the early stage, and have the support of their senior colleagues. Moreover, GPs need to take the opportunities provided by CME to share difficulties when dealing with individual patients and build the team to cope with different professional environments.[27] Significant event audit is a regular and compulsory part of annual appraisal for all doctors in the NHS in the UK.[28]

Our survey found that the current CME participation fell short of the overall 95% standard from the "Twelfth Five Years Plan",[15] where 92% of doctors and 89% of nurses surveyed reported regular CME participation. However, contrary to what was believed by the policymakers (as reflected in the targets set), participation rates for doctors from the Western and peripheral region CME not only exceeded the target, but also those of junior titles participated more than their counterparts in the other regions, which suggested such regional differentiation is unnecessary.

Conclusion

This is the first representative study examining the current primary care workforce and their continuous education in mainland China. The high participation rates of CME amongst health professionals in CHCs, if used well, could maintain high standards of practice amongst the primary care work force in China. The current emphasis of CME is on updating knowledge of diseases and discussion of therapeutic protocols. Those registered as GPs have better CME participation rates than those who registered as specialists but there are no significant differences among CME participation rates in CHC staff (except in junior doctors) in three regions of China.

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Conflict of Interest

The authors declare that they have no competing interests to declare.

Ethical Considerations

Ethics Committee approvals from a local board (HKU/HAW IRB: UW15-350) and the World Health Organization Regional Office for the Western Pacific (2016.4.CHN.1.HSI) were obtained.

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Contributorship Statement

William CW Wong designed the study and the questionnaire, and wrote up the report. ShanZhu Zhu led the team and oversaw the implementation, and liaised with different Chinese GP Associations. Jason Ong conducted the data analysis, and drafted the results of the manuscript with William CW Wong. MingHui Peng implemented the study and helped some of the data analysis. Cindy L. K. Lam, Michael R Kidd and Martin Roland advised on the study design and questionnaire, and commented on the reports. SunFang Jiang led the team and oversaw the implementation, led the pilot testing as well as implementation of the study, took part in the discussion and modification of the design and the questionnaire.

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Table 1. Basic characteristics and training of CHC health professionals

Variables	DOCTORS		NURSES	
	n/N	**% (95%CI)**	**n/N**	**% (95%CI)**
Median Age **(IQR)**		38 (32-46)		31 (26-39)
Gender				
Female	1,025/ 1675	61.2 (58.8-63.5)	1,793/ 1803	99.4 (99.0-99.7)
Education				
Below associate degree	202/ 1724	11.7 (10.2-13.3)	382/ 1831	20.9 (19.0-22.8)
Associate degree*	582/ 1724	33.8 (31.5-36.0)	920/ 1831	50.2 (47.9-52.6)
Bachelor degree or	940/	54.5 (52.1-	529/	28.9 (26.8-31.0)

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higher	1724	56.9)	1831	

Variables	CHCs		DOCTORS	
Job title				
Senior	180/ 1711	10.5 (9.1-12.1)	46/ 1815	2.5 (1.9-3.4)
Intermediate	705/ 1711	41.2 (38.9-43.6)	471/ 1815	26.0 (23.9-28.0)
Junior	683/ 1711	39.9 (37.6-42.3)	1,158/ 1815	63.8 (61.5-66.0)
None	143/ 1711	8.4 (7.1-9.8)	140/ 1815	7.7 (6.5-9.0)
Registered Speciality				
Integrative Medicine	145/ 1700	8.5 (7.2-10.0)	2/ 1834	0.1 (0.0-0.4)
General practice	799/ 1700	47.0 (44.6-49.4)	85/ 1834	4.6 (3.7-5.7)
Other Specialty	454/ 1700	26.7 (24.6-28.9)	19/ 1834	1.0 (0.6-1.6)
Nurse	23/ 1700	1.4 (0.9-2.0)	1712/ 1834	93.3 (92.1-94.4)
None	75/ 1700	4.4 (3.5-5.5)	30/ 1834	1.6 (1.1-2.3)
Other	295/ 1700	17.4 (15.6-19.2)	18/ 1834	1.0 (0.6-1.5)
Median Years working in above speciality (IQR)	14 (7-23)		9 (4-18)	

* Associate degree refers to 2-years health related sub-degree equivalent to a physician assistant

CI=Confidence interval, IQR = interquartile range

Table 2. Continuous medical education organised and undertaken by CHC staff

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	n/N	% (95%CI)	n/N	% (95%CI)	n/N	% (95%CI)
Organisation of CME activities						
Continuous Medical education	140/144	97.2 (93.0-99.2)				
Frequency of CME organised at CHCs						
Yearly	16/148	10.8 (6.3-17.0)	-	-	-	-
Quarterly	25/148	16.9 (11.2-23.9)	-	-	-	-
Bimonthly	13/148	8.8 (4.8-14.6)	-	-	-	-
Monthly	77/148	52.0 (43.7-60.3)	-	-	-	-
Biweekly	15/148	10.1 (5.8-16.2)	-	-	-	-
Weekly	2/148	1.4 (0.2-4.8)	-	-	-	-
Who involves in learning activities organised by CHC						
Managers	140/145	96.6 (92.0-99.0)	-	-	-	-
Doctors	147/147	100.0 (97.5-100.0)	1455/1588	91.6 (90.2-92.9)		
Nurses	146/146	100.0 (97.5-100.0)	-	-	1502/1683	89.2 (87.7-90.7)
Other medical staff	126/142	88.7 (82.3-93.4)	-	-	-	-
Types of CME activities						
Diagnostic and treatment guideline and discussion	141/145	97.2 (93.1-99.2)	1263/1449	87.2 (85.3-90.7)	894/1395	64.1 (61.5-66.6)
Management updates	123/145	84.8 (77.9-90.2)	1116/1384	80.6 (78.5-82.7)	872/1389	62.8 (60.2-65.3)
Case discussions	117/139	84.2 (77.0-93.0)	1084/1371	79.1 (76.8-81.2)	768/1341	57.3 (54.6-59.9)

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Table 3. CME participation for different types of health professionals according to the three administrative districts

	CENTRAL		WESTERN & PERIPHERIAL		EASTERN		$\chi 2$	*p-value*
	n/N	**% (95%CI)**	**n/N**	**% (95%CI)**	**n/N**	**% (95%CI)**		
Health professionals	701/786	89.2 (86.8-91.3)	916/1018	90.0 (88.0-91.8)	1519/1655	91.8 (90.4-93.1)	5.04	0.08
Doctors	370/407	90.9 (87.7-93.5)	424/462	91.8 (88.9-94.1)	751/807	93.1 (91.1-94.7)	1.89	0.39
Nurse	331/379	87.3 (83.6-90.5)	492/556	88.5 (85.5-91.0)	768/848	90.6 (88.4-92.4)	3.31	0.19
Job titles								
Intermediate & Senior	270/282	95.7 (92.7-97.8)	280/290	96.9 (93.8-98.3)	764/786	97.2 (95.8-98.2)	1.46	0.48
Junior	399/456	87.5 (84.1-90.4)	525/569	92.3 (89.8-94.3)	681/763	89.3 (86.8-91.4)	6.64	0.036
Education level								
Bachelor & higher	380/442	86.0 (82.4-89.1)	646/731	88.4 (85.8-90.6)	739/829	89.1 (86.8-91.2)	2.83	0.24
Associate degree and below	316/339	93.2 (90.0-95.7)	265/282	94.0 (90.5-96.4)	770/814	94.6 (92.8-96.0)	0.85	0.66
Registered specialty								
GPs	146/151	96.7 (92.3-98.9)	143/143	100 (97.5-100)	464/487	95.0 (73.0-97.0)	5.73	0.057
Specialists	217/246	88.2 (83.5-92.0)	272/308	88.3 (84.2-91.7)	281/316	88.9 (84.9-91.2)	0.087	0.96

Table 4 Crude and adjusted odds ratios for participation in CME by health professionals

Participation in CME for doctors (n=1587)	Crude OR (95% CI)	p value	Adjusted OR* (95% CI)	p value
Age	1.08 (1.06-1.11)	<0.01	1.04 (1.02-1.07)	<0.01
Female	1.86 (1.24-2.79)	<0.01	1.72 (1.12-2.63)	0.01
Graduate degree or above	1.45 (1.02-2.08)	0.04	-	-
GP specialty	4.24 (2.69-6.67)	<0.01	2.97 (1.83-4.81)	<0.01
Years working in occupation	1.07 (1.04-1.09)	<0.01	-	-
Senior or intermediate job title (junior title as **ref0reference)**	4.22 (2.74-6.48)	<0.01	2.16 (1.31-3.56)	<0.01

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Participation in CME for nurses (n=1683)	Crude OR (95% CI)	p value	Adjusted OR (95% CI)	p value
Age	1.09 (1.06-1.11)	<0.01	-	
Graduate degree or above	3.29 (2.10-5.16)	<0.01	2.85 (1.79-4.55)	<0.01
Years working in occupation	1.10 (1.07-1.13)	<0.01	1.08 (1.05-1.11)	<0.01
Senior or intermediate job title (junior title as reference)	1.59 (1.06-2.11)	<0.01	2.16 (1.17-4.00)	0.01

* Adjusted for gender, medical specialty, years working in the CHC, job title and education level

CI = confidence interval, OR = odds ratio

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Primary Care Workforce and Continuous Medical Education in China: Lessons to learn from a Nationwide Representative Survey

Short title: Workforce and continuous medical education in primary care in China

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Abstract

Objectives

This study aimed to examine the education and training background of Chinese community health centres (CHC) staff, continuous medical education (CME) and factors affecting participation in CME.

Design Cross-sectional survey

Setting Community health centres **(**CHCs)

Participants All doctors and nurses working in selected CHCs (excluding those solely practising traditional Chinese Medicine)

Main Outcome Measures CME recorded by CHCs and self-reported CME participation

Methods

A stratified random sample of CHCs based on geographical distribution and 2:1 urban-suburban ratio was selected covering three major regions of China. Two questionnaires, one for lead clinicians and another for frontline health professionals, were administered between September-December 2015, covering the demographics of clinic staff, staff training and CME activities.

Results

149 lead clinicians (response rate 79%) and, 1,734 doctors and 1,846 nurses completed the survey (response rate 86%). 54.5% of the doctors had a bachelor degree and only 47% were registered as general practitioners (GPs). 10.5% of doctors carried senior titles. Few nurses (4.6%) had training in primary care. 91.6% of doctors and 89.2% of nurses reported participating in CME. CME participation in doctors was more commonly reported by older doctors, females, those who were registered as a GP and those with intermediate or senior job titles. CME participation in nurses was commoner among those with a bachelor degree or intermediate/senior job titles, or those with longer working experience in the CHC.

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Conclusion

This representative survey confirms only half of doctors have bachelor degrees or are registered as GPs as their prime registration in the primary care workforce in China. The vast majority of CHC staff participated in CME but there is room for improvement in how CME is organised.

Key words Continuous medical education, Training, Quality of care, Primary care, China

Strengths and limitations

This study was the first study to survey the CME situation of a representative sample of medical staff in CHCs in mainland China reported in the international literature. We focused on doctors and nurses working in CHCs, who are the core of the primary care workforce. It has been reported that the majority of CME programmes in China were based on the concept of institutionally-oriented planning, dictated by the interests of these organisation rather than the needs of learners[1]. Therfore, our study provides a useful baseline of the frequency and types of locally-organised CME activities across a large number of CHCs. The main limitation of this study is that we focused on CME activities that were organised by CHCs but arguably those were the most commonly attended by the staff of individual CHCs. We did not evaluate the quality of CME being delivered nor whether observable health improvements had resulted from CME participation. Moreover, social desirability might constitute a threat in such self-reported surveys especially if participation in the survey was encouraged by the supervisors. These could be the subject of future research through in-depth qualitative interviews of CHC staff and focused evaluations of CME programs in China.

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Introduction

The importance of a strong primary care system based on first contact access and provision of person-focused comprehensive care with continuity and coordination, is widely accepted.[2-7] Despite a strong primary care system being repeatedly shown to be an effective approach at reducing health inequity and achieving universal health coverage,[3] many countries have yet to develop a robust primary healthcare system. Instead, primary care services are often characterized by inadequate resources and facilities, lack of appropriate training for their medical staff, variable quality in delivery of care and fragmented care.[8] In China, these problems were further compounded by economic and healthcare reforms in the 1980s which involved fiscal decentralization, commercialization of medical services, and underfunding of the public healthcare sector. These turned a generation of health professionals and the general public to rely heavily on high-tech diagnostics, expensive drugs and specialist procedures.[9,10] These factors reinforced unrealistic patient expectations focused on specialist diagnostic aids and procedures, while alienating cost-efficient primary care that would better suit the nation's health needs.[11]

In 2009, the Chinese government responded to these problems and committed themselves to re-establishing primary healthcare.[12] According to Health & Family Planning Commission, expenditure on primary care has reached USD17.74 billion (1USD=¥6.20) and accounted for approximately 30% of the public spending on health in 2014.[13] In fewer than ten years, the Chinese Government has succeeded in establishing a primary care infrastructure composed mainly of rural township centres, village clinics and community health centres (CHCs) in cities. By 2014, 8,669 CHCs were established, employing over 300,000 health professionals, the great majority of which were from the established rural practices. However, the historical image of 'barefoot doctors' who had worked in rural regions since the 1950s, criticism of the

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healthcare system by end-users, and negative publicity by the media have all led to a breakdown of trust between patients and health professionals, including in the newly-revamped primary care system.[10] This problem appears particularly pronounced in the cities where patients have greater choice and easier access to hospitals. One of the major problem is that CHC health professionals (doctors and nurses included) are regarded as poorly qualified and trained, and CHCs are poorly resourced, providing "low tech" facilities.[14]

In the past, medical courses were offered by a variety of colleges, vocational training schools and universities, ranging from 2-8 years of training. Graduates of these courses would have to sit and pass board examinations to be registered for their chosen specialties. Although shorter courses are still available to train the rural workforce, five-year undergraduate programs based at the university are now the norm to enter into vocational training. Nonetheless, general practice is a relatively new clinical discipline in China and there are currently few general practice departments in medical schools.[15] Hence, the exposure to general practice and primary care teaching at the undergraduate level is minimal and the discipline has a low status amongst other clinical disciplines.

At the vocational training level, the emphasis has been on implementing the new policy of establishing primary care in a very short time span through re-orientation of specialists to general practice, initially by "on-the-job training" and later replaced by "job-transfer" training. "Job-transfer training" is a one-year long programme aimed at the less qualified doctors currently working at CHCs or those who have not undergone "on-the-job training" which entailed a series of short courses to enhance their theoretical knowledge of general practice and practical clinical skills through a combination of lectures, hospital rotations and community-based placements. Since

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2011 this has been replaced by a three-year structured program with 2.5 years in hospital rotations followed by six months in the community.

Continuous medical education (CME) aimed at maintaining, developing and enhancing medical providers' professional knowledge, skills and interpersonal capacity to keep abreast of professional lives, is an essential element to maintain quality of care in this new system[16,17] and CME is compulsory for ongoing registration in China. These CHC staff are required to participate in CME organised by training institutions at national, provincial, municipal, district and center level, and they have to fulfil at least 25 credits of approved CME every year which is accredited every two years. According to the "Twelfth 5-year plan" ,[18] 100% of senior, 95% of mid-grade; and 80% of junior health professionals at provincial and city levels should achieve the required CME targets over two years. For staff working in western and peripheral regions of China, these targets were reduced to 95%, 80% and 70% respectively to reflect the phased development of primary care in these large and dispersed regions of the country. The hierarchy of the titles can only be achieved after passing the qualifying examination and fulfilling a number of stringent criteria including CME requirements, written examinations and publication of research manuscripts. This study aimed to evaluate the current organization and manpower of CHCs in China, as well as the training (especially the content and delivery of CME) of health professionals within primary care in China.

Methods

A nationwide representative survey using a stratified randomized sample was conducted amongst CHC medical professionals between September and December 2015. China was divided into three administrative regions: central, eastern and western. Two provinces were randomly selected from each region; and from these, the

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capital city and two district-level cities were selected at random. In addition, two of the four major municipalities (Beijing, Shanghai, Chongqing and Tianjin) were also selected at random and included in the sample. In total, twenty cities were chosen from the provinces and municipalities combined. From these, nine CHCs were randomly selected from each city (with an urban-to-suburban ratio of 2:1), giving a total of 180 CHCs. The lead clinicians and all doctors and nurses (excluding traditional Chinese herbalists) with direct patient contact from these selected CHCs were invited to participate in the survey.

The local chairpersons of the General Practitioner Associations of the six selected provinces and two selected municipalities were contacted, whom in turn, contacted the randomly selected CHCs. Training on how to distribute and complete the survey questionnaire was arranged for the coordinators of each province or municipality prior to the study. These coordinators were responsible for tracking and collecting the questionnaires. Collected data was entered and cleaned using EPIDATA 3.1. A data entry team was responsible for data input and appointed personnel for auditing and quality control.

The study consisted of two questionnaires, one for the lead clinicians and another for CHC staff (i.e. doctors and nurses). The former (Appendix 1) covered current clinical set-up, range of services and staff composition, community characteristics and patient demographics; as well as information on CME organized at the clinic. In this survey we asked the lead clinician to use their own records to estimate the median population size of the catchment area and number of patient contacts in the past year. In the second survey, we asked the frontline health professionals about their training experience, CME participation and their willingness to conduct certain testing services. CME organized by CHCs was compared with actual participation reported by the CHC staff. These surveys were pilot-tested twice on three CHCs and twenty-

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five practitioners with modifications made accordingly. Detailed methodology and, availability and use of primary care facilities is reported elsewhere.[19]

Descriptive analyses were conducted for percentages and frequencies of key parameters. Confidence intervals for the sample proportions were calculated using the Agresti-Coull (adjusted Wald) method. CME participation and content were broken down according to the three administrative districts which have different requirements for CME participation. Univariate logistic regression was used to explore the staff characteristics as the independent factors (with crude odds ratios (OR) and 95% confidence intervals (CI) calculated) associated with participation of CME by the health professionals after adjusting for gender, medical specialty, years working in the CHC, job title and education level. We also examined factors related to the clinical set up, range of services offered, staff composition, community characteristics and patient demographics (see Appendix 1 for full list of variables from questionnaire) and present in the paper factors which were statistically significant. All variables with p values <0.10 was included in the multivariate model and through backward elimination, we report the final variables (with adjusted odds ratios (AOR)) with a p-value less than 0.05 as statistically significant by convention. We adjusted the final model for age, gender, medical specialty, years working in the CHC, job title and education level. Data were analyzed using STATA (StataCorp. 2013. *Stata Statistical Software: Release 13.* College Station, TX: StataCorp LP).

Results

One hundred and forty-nine out of the 189 CHCs contacted provided data on their CHC (79% response rate). **Figure** 1 shows the distribution of CHCs surveyed in China. The median number of fulltime general practitioners working at CHC was 8 (interquartile range (IQR) 4-14) and fulltime nurses was 13 (IQR 8-12). Of the 4,146 health professionals invited, 1,734 doctors and 1,846 nurses completed the survey

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giving a response rate of 86%. A very small percentage of them might have double qualifications in medicine and nursing.

The median population size of the catchment area of each CHC was 50,000 people (IQR 30,000 to 96,000) with a migrant population of 11,100 (IQR 5,000-30,000). The median patient contacts per year was 41,100 (IQR 12,000 to 163,600). Table 1 provides the demographics of CHC staff. The median age of CHC doctors and nurses were young at 38 and 31 years of age, respectively. Women accounted for 61% of the doctors and nearly all the nurses, with a nurses-to-doctor ratio of 1.6. 54.5% of the doctors had bachelor degrees or above, yet only 10.5% of them had acquired senior titles. Despite the fact that all were practising as general practitioners (GPs), only 47% were actually registered as one. Doctors and nurses had worked for a median of 14 years and 9 years, respectively.

Table 2 shows the range and frequency of reported on-site CME and CME participation. CME activities were held by nearly all CHCs (97.2%), nearly two-thirds (63.5%) holding CME sessions monthly or more frequently. According to the lead clinicians, all health professionals would have participated in CME, more frequently than managers (95%) and other health professionals (88%). However, when this figure was compared with the individual health professionals' survey, 91.6% of doctors and 89.2% of nurses reported participating in CME. The type of in-house CME activities reported were clinical guidelines discussion (97.2%), management updates e.g. journal clubs (84.8%) and case discussions (84.2%). Notably nurses reported much less involvement in the variety of CME activities (57.3-64.1%).

Table 3 shows CME participation for different types of health professionals in the three administrative districts. Despite CME participation being extremely high

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(ranging between 86% to 100%), those in the central and eastern regions fell short of the targets set by the State. In contrast to what was expected by the government, there was no significant difference of CME participation by GPs in the three administrative regions and CME participation was actually commoner among junior doctors in the western and peripheral regions compared to the central and eastern regions (p=0.036).

Table 4 summarizes the multivariate analysis of health professionals' characteristics with CME participation. Amongst doctors, CME participation was commoner among older doctors (adjusted odds ratios (aOR) 1.04 per year), women (aOR 1.7), those registered as GPs (aOR 3.0) and those with an intermediate or senior job title (aOR 2.2). Amongst nurses, CME participation was commoner among those with bachelor degrees (aOR 2.9), with longer experience working in general practice (aOR 1.1 per year) or with an intermediate or senior job title (aOR 2.2).

Discussion

This large representative study of China's CHCs examines the current primary care workforce and finds it is predominantly staffed by young female health professionals, with only half of doctors holding a bachelor degree or higher, or registered as a GP. The relatively low nurse-to-doctor ratio may reflect the focus of care on doctor-centred approach in the traditional medical model. Indeed the lead physicians reported on average there were 1-2 pharmacists, physiotherapists, laboratory technicians or radiographers but clinical psychologists or medical social workers were uncommon.[13] The ratio was far from the international standard of approximately three nurses per doctors as recommended by World Health Organization (WHO).[20] Evidence exists that an undersupply of nurses could result in inefficient allocation of resources.[21]

For historical reasons, many practicing health professionals at CHCs do not have a

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bachelor degree.[15] Indeed, our study shows just over half of the doctors and under a third of the nurses working in primary care have a bachelor degree. This may contribute in part to the perception of poor training and poor quality in primary care. The quality of health care should be based upon the quality of the workforce rather than just increasing the sheer quantity of staff as it has been the focus of China's policy on development of primary care thus far. The education level and title seniority through examination are considered important indictors of professional standards and competency. Nurses who have a higher level of education provide better health care and safety for their patients.[22]

In China, due to the short history of primary care development, many senior doctors were previously either public health physicians or specialist who converted to being GPs and were given the task of setting up CHCs. Previously "on-the-job" and now "job-transfer" training is offered to the specialists who have converted to work as GPs before sitting the qualifying examination. In order to attract them to primary care, they are allowed to keep up to three specialties on their registration but in our survey, only 47% of the doctors chose to register general practice as their prime registration. We confirm that the CME participation rates for those registered as GPs are higher than those still registered as a specialist. Further, 97% of staff members with intermediate and senior level job titles participated in CME, which accounted for 39% of all CHC health professionals (52% of GPs and 29% of nurses). An advancement in job titles may provide a sense of ownership and autonomy,[10] and thus was identified as an independent factor in the participation of CME in our study.

CME is a requirement for practicing professionals in many countries including China in order to maintain medical knowledge and skills.[23] Doctors who do not participate in CME have lower confidence when making clinical decisions.[22] Although it is

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encouraging to see nearly all CHC staff had participated in CME, one-third of CHCs organize on-site CME activities once every quarter or even once a year, which is far from satisfactory. A Cochrane review suggests that CME should be accessible within health professionals' own clinical communities.[24] Other forms of CME might include attending professional conferences, research workshops or distance learning courses so long as they have been approved by the postgraduate center in their respective city but the focus of CME undergone by doctors or nurses could be different and there is no fixed rules as how frequent they should attend these activities. Learning objectives must be tailored beyond meeting the staff's CME requirements where each CHC or jointly in a locality should take into account the local context and needs e.g. the local disease pattern and epidemiology, and to provide the necessary training and support to their staff to address the skill-mix to deliver the service.

Arguably, reflective learning, meeting self-defined learning objectives and auditing clinical performance with practitioners expected to demonstrate certain competencies in managing the patients independently, would be more appropriate in quality improvement rather than time-based training.[22] Lack of time and appropriate resources have been reported as obstacles for CME participation in China.[25] Alternatives such as self-directed searches in the medical literature or medical websites, or structured resources on the internet (e.g. BMJ learning) or medical journals, exist to meet their learning needs.[26,27] Nonetheless these alternatives are limited by the motivation and skills required to perform these searches effectively as well as the availability and accessibility (including the language barrier) of these resources.

Our study suggests that 97.2% of CHCs hold discussions and learning sessions about treatment protocols and 84.8% on disease updates. If used well, evidence-based medicine can aid health professionals in making the most appropriate therapeutic decisions for individual patients and conditions at the clinical level. However, rapid

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advancements in therapeutic methods and multiple guidelines from both local and international agencies have made it difficult for health professionals to follow them closely. Primary healthcare staff can learn and incorporate these new updates and guidelines into their clinical practices only when they engage in the dissemination and implementation at the early stage, and have the support of their senior colleagues. Moreover, GPs need to take the opportunities provided by CME to share difficulties when dealing with individual patients and build the team to cope with different professional environments.[28] Significant event audit is a regular and compulsory part of annual appraisal for all doctors in the NHS in the UK.[29]

Our survey found that the current CME participation fell short of the overall 95% standard from the "Twelfth Five Years Plan",[16] where 92% of doctors and 89% of nurses surveyed reported regular CME participation. Contrary to what was believed by the policymakers (as reflected in the targets set), participation rates for doctors from the Western and peripheral region CME not only exceeded the target, but evidently Western and peripheral region doctors of junior title had participated more than their counterparts in the other regions, which suggests such regional differentiation is unnecessary.

Conclusion

In this study, it shows the high participation rates of CME amongst health professionals in CHCs, if used well, could maintain high standards of practice amongst the primary care workforce in China. CHCs could focus on improving nurses-to-doctor, bachelors-to-non-graduate and title seniority ratios as quality workforce improvements. There are disadvantages to continue to rely on conversion of specialists as a source of primary care worksforce. At the same time, CME

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programmes should be decentralised and take on various forms to meet the local and individual needs whilst regional CME differentiation is unnecessary.

Conflict of Interest

The authors declare that they have no competing interests to declare.

Ethical Considerations

Ethics Committee approvals from a local board (HKU/HAW IRB: UW15-350) and the World Health Organization Regional Office for the Western Pacific (2016.4.CHN.1.HSI) were obtained.

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Contributorship Statement

William CW Wong designed the study and the questionnaire, and wrote up the report. ShanZhu Zhu led the team and oversaw the implementation, and liaised with different Chinese GP Associations. Jason Ong conducted the data analysis, and drafted the results of the manuscript with William CW Wong. MingHui Peng implemented the study and helped some of the data analysis. Cindy L. K. Lam, Michael R Kidd and Martin Roland advised on the study design and questionnaire, and commented on the reports. SunFang Jiang led the team and oversaw the implementation, led the pilot testing as well as implementation of the study, took part in the discussion and modification of the design and the questionnaire.

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Table 1. Basic characteristics and training of CHC health professionals

Variables	DOCTORS		NURSES	
	n/N	**% (95%CI)**	**n/N**	**% (95%CI)**
Median Age **(IQR)**		38 (32-46)		31 (26-39)
Gender				
Female	1,025/ 1675	61.2 (58.8-63.5)	1,793/ 1803	99.4 (99.0-99.7)
Education				
Below associate degree	202/ 1724	11.7 (10.2-13.3)	382/ 1831	20.9 (19.0-22.8)
Associate degree*	582/ 1724	33.8 (31.5-36.0)	920/ 1831	50.2 (47.9-52.6)
Bachelor degree or higher	940/ 1724	54.5 (52.1-56.9)	529/ 1831	28.9 (26.8-31.0)
Job title				
Senior	180/ 1711	10.5 (9.1-12.1)	46/ 1815	2.5 (1.9-3.4)
Intermediate	705/ 1711	41.2 (38.9-43.6)	471/ 1815	26.0 (23.9-28.0)
Junior	683/ 1711	39.9 (37.6-42.3)	1,158/ 1815	63.8 (61.5-66.0)
None	143/ 1711	8.4 (7.1-9.8)	140/ 1815	7.7 (6.5-9.0)
Registered Speciality				
Integrative Medicine	145/ 1700	8.5 (7.2-10.0)	2/ 1834	0.1 (0.0-0.4)
General practice	799/ 1700	47.0 (44.6-49.4)	85/ 1834	4.6 (3.7-5.7)
Other Specialty	454/ 1700	26.7 (24.6-28.9)	19/ 1834	1.0 (0.6-1.6)
Nurse	23/ 1700	1.4 (0.9-2.0)	1712/ 1834	93.3 (92.1-94.4)
None	75/ 1700	4.4 (3.5-5.5)	30/ 1834	1.6 (1.1-2.3)
Other	295/ 1700	17.4 (15.6-19.2)	18/ 1834	1.0 (0.6-1.5)
Median Years working in above speciality (IQR)	14 (7-23)		9 (4-18)	

* Associate degree refers to 2-years health related sub-degree equivalent to a physician assistant

CI=Confidence interval, IQR = interquartile range

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Table 2. Continuous medical education organised and undertaken by CHC staff

Variables	CHCs		DOCTORS		NURSES	
	n/N	% (95%CI)	n/N	% (95%CI)	n/N	% (95%CI)
Organisation of CME activities						
Continuous Medical education	140/144	97.2 (93.0-99.2)				
Frequency of CME organised at CHCs						
Yearly	16/148	10.8 (6.3-17.0)	-	-	-	-
Quarterly	25/148	16.9 (11.2-23.9)	-	-	-	-
Bimonthly	13/148	8.8 (4.8-14.6)	-	-	-	-
Monthly	77/148	52.0 (43.7-60.3)	-	-	-	-
Biweekly	15/148	10.1 (5.8-16.2)	-	-	-	-
Weekly	2/148	1.4 (0.2-4.8)	-	-	-	-
Staff participating in CME						
Managers	140/145	96.6 (92.0-99.0)	-	-	-	-
Doctors	147/147	100.0 (97.5-100.0)	1455/1588	91.6 (90.2-92.9)		
Nurses	146/146	100.0 (97.5-100.0)	-	-	1502/1683	89.2 (87.7-90.7)
Other medical staff	126/142	88.7 (82.3-93.4)	-	-	-	-
Types of CME activities						
Clnical guideline discussion	141/145	97.2 (93.1-99.2)	1263/1449	87.2 (85.3-90.7)	894/1395	64.1 (61.5-66.6)
Management updates	123/145	84.8 (77.9-90.2)	1116/1384	80.6 (78.5-82.7)	872/1389	62.8 (60.2-65.3)
Case discussions	117/139	84.2 (77.0-93.0)	1084/1371	79.1 (76.8-81.2)	768/1341	57.3 (54.6-59.9)

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Table 3. CME participation for different types of health professionals according to the three administrative districts (as reported by CHC staff, n=3,580)

	CENTRAL		WESTERN & PERIPHERIAL		EASTERN		$\chi 2$	*p-value*
	n/N	**% (95%CI)**	**n/N**	**% (95%CI)**	**n/N**	**% (95%CI)**		
Health professionals	701/786	89.2 (86.8-91.3)	916/1018	90.0 (88.0-91.8)	1519/1655	91.8 (90.4-93.1)	5.04	0.08
Doctors	370/407	90.9 (87.7-93.5)	424/462	91.8 (88.9-94.1)	751/807	93.1 (91.1-94.7)	1.89	0.39
Nurse	331/379	87.3 (83.6-90.5)	492/556	88.5 (85.5-91.0)	768/848	90.6 (88.4-92.4)	3.31	0.19
Job titles								
Intermediate & Senior	270/282	95.7 (92.7-97.8)	280/290	96.9 (93.8-98.3)	764/786	97.2 (95.8-98.2)	1.46	0.48
Junior	399/456	87.5 (84.1-90.4)	525/569	92.3 (89.8-94.3)	681/763	89.3 (86.8-91.4)	6.64	0.036
Education level								
Bachelor & higher	380/442	86.0 (82.4-89.1)	646/731	88.4 (85.8-90.6)	739/829	89.1 (86.8-91.2)	2.83	0.24
Associate degree and below	316/339	93.2 (90.0-95.7)	265/282	94.0 (90.5-96.4)	770/814	94.6 (92.8-96.0)	0.85	0.66
Registered specialty								
GPs	146/151	96.7 (92.3-98.9)	143/143	100 (97.5-100)	464/487	95.0 (73.0-97.0)	5.73	0.057
Specialists	217/246	88.2 (83.5-92.0)	272/308	88.3 (84.2-91.7)	281/316	88.9 (84.9-91.2)	0.087	0.96

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Table 4 Crude and adjusted odds ratios for participation in CME by health professionals

Participation in CME for doctors (n=1587)	Crude OR (95% CI)	p value	Adjusted OR* (95% CI)	p value
Age	1.08 (1.06-1.11)	<0.01	1.04 (1.02-1.07)	<0.01
Female	1.86 (1.24-2.79)	<0.01	1.72 (1.12-2.63)	0.01
Graduate degree or above	1.45 (1.02-2.08)	0.04	-	-
GP specialty	4.24 (2.69-6.67)	<0.01	2.97 (1.83-4.81)	<0.01
Years working in occupation	1.07 (1.04-1.09)	<0.01	-	-
Senior or intermediate job title (junior title as reference)	4.22 (2.74-6.48)	<0.01	2.16 (1.31-3.56)	<0.01
Participation in CME for nurses (n=1683)				
Age	1.09 (1.06-1.11)	<0.01	-	
Graduate degree or above	3.29 (2.10-5.16)	<0.01	2.85 (1.79-4.55)	<0.01
Years working in occupation	1.10 (1.07-1.13)	<0.01	1.08 (1.05-1.11)	<0.01
Senior or intermediate job title (junior title as reference)	1.59 (1.06-2.11)	<0.01	2.16 (1.17-4.00)	0.01

* Adjusted for age, gender, medical specialty, years working in the CHC, job title and education level

CI = confidence interval, OR = odds ratio

Figure 1 Geographical distribution of the selected cities participated in the survey

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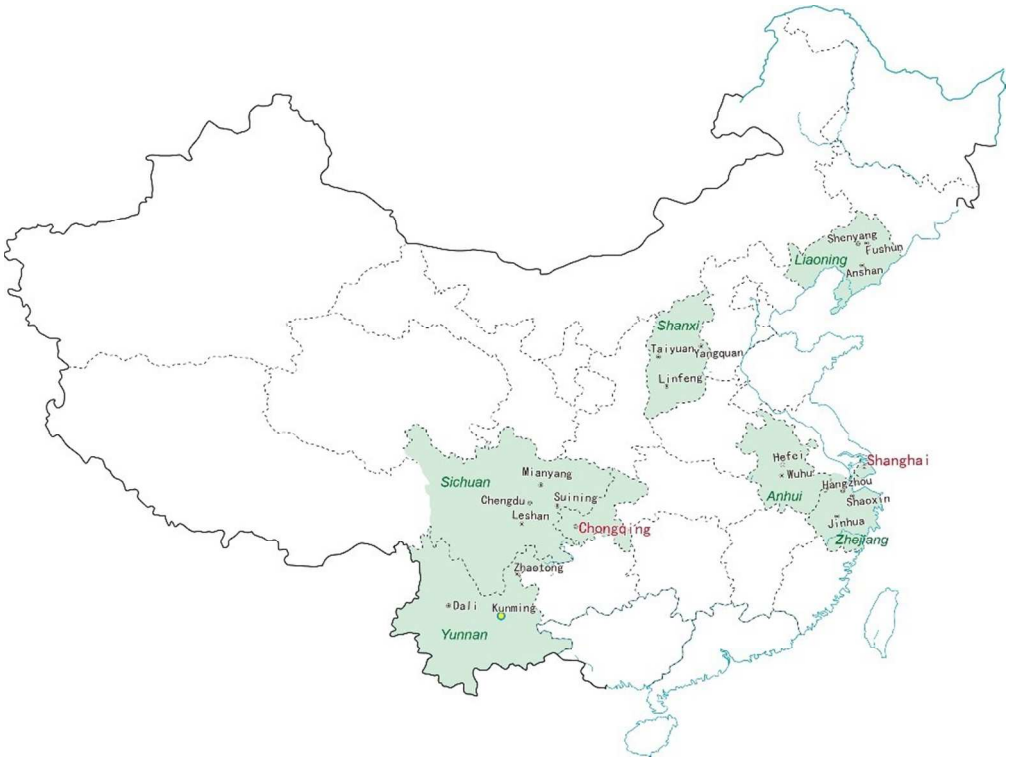

Geographical distribution of the selected cities participated in the survey

120x90mm (220 x 220 DPI)

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Appendix 1

The factors considered for an association with CME participation were:

- Age (continuous variable)
- Gender (Male, Female)
- Ethnicity (Han, Minority, Other)
- Highest Qualification (Lower than associate degree, associate degree, graduate degree with postgraduate qualifications)
- Registered specialty (Integrative medicine, General practice, Other specialty, Nurse, None)
- Current field of work (Integrative Medicine, General, Other specialty, Nurse, None)
- Years of practice in current field of work (continuous variable)
- Title of technical post (Senior, Intermediate, Junior, None)
- Hours spent on patient care (continuous variable)
- Patients in CHC in the last month (Intravenous drug user, female sex worker, male sex worker, men who have sex with men, transgender people)
- Training in HIV prevention, counselling, diagnosis and care (yes/no)
- Training in common STI prevention counselling, diagnosis and care (yes/no)
- Attitudes towards HIV/STI testing in key populations (strongly disagree/disagree, neither agree or disagree/agree/strongly agree/don't know)
    - I think routine STI testing is an important part of regular healthcare
    - I am concerned about cost and reimbursement for STI testing
    - I am concerned that patients will be offended by being offered routine STI testing
    - I am comfortable discussing routine STI testing with patients
    - Language barriers prevent some patients from receiving routine STI testing
    - Patients often feel like they have to accept routine STI testing
    - Patients receive adequate post-test information for routine STI testing
    - Routine STI testing is voluntary; patients are able to decline screening
    - Patients do not expect to be offered routine STI testing
    - I am concerned that routine STI testing will have a negative effect on patients' opinions about our clinic
    - We have the resources needed to implement STI testing
    - It is difficult to provide the privacy needed for routine STI testing
    - I think routine HIV testing is an important part of regular healthcare
    - I am concerned about cost and reimbursement for HIV testing
    - I am concerned that patients will be offended by being offered routine HIV testing
    - I am comfortable discussing routine HIV testing with patients
    - Language barriers prevent some patients from receiving routine HIV testing
    - Patients often feel like they have to accept routine HIV testing
    - Patients receive adequate pre-test information for routine HIV testing
    - Patients receive adequate post-test information for routine HIV testing
    - Routine HIV testing is voluntary; patients are able to decline screening
    - Patients do not expect to be offered routine HIV testing
    - I am concerned that routine HIV testing will have a negative effect on patients' opinions about our clinic

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- We have the resources needed to implement HIV testing
- It is difficult to provide the privacy needed for routine HIV testing
- I can ask the sexual orientation of the patients
- I can obtain a sexual and reproductive health history from the patients

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Reporting checklist

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Primary Care Workforce and Continuous Medical Education in China: Lessons to learn from a Nationwide Survey

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Manuscripts

Primary Care Workforce and Continuous Medical Education in China: Lessons to learn from a Nationwide Survey

Short title: Workforce and continuous medical education in primary care in China

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Abstract

Objectives

This study aimed to examine the education and training background of Chinese community health centres (CHC) staff, continuous medical education (CME) and factors affecting participation in CME.

Design

Cross-sectional survey

Setting

Community health centres (CHCs)

Participants

All doctors and nurses working in selected CHCs (excluding those solely practising traditional Chinese Medicine)

Main Outcome Measures

CME recorded by CHCs and self-reported CME participation

Methods

A stratified random sample of CHCs based on geographical distribution and 2:1 urban-suburban ratio was selected covering three major regions of China. Two questionnaires, one for lead clinicians and another for frontline health professionals, were administered between September-December 2015, covering the demographics of clinic staff, staff training and CME activities.

Results

149 lead clinicians (response rate 79%) and, 1,734 doctors and 1,846 nurses completed the survey (response rate 86%). 54.5% of the doctors had a bachelor degree and only 47% were registered as general practitioners (GPs). 10.5% of doctors carried senior titles. Few nurses (4.6%) had training in primary care. 91.6% of doctors and 89.2% of nurses reported participating in CME. CME participation in doctors was more commonly reported by older doctors, females, those who were registered as a

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GP and those with intermediate or senior job titles. CME participation in nurses was commoner among those with a bachelor degree or intermediate/senior job titles, or those with longer working experience in the CHC.

Conclusion

Only half of doctors have bachelor degrees or are registered as GPs as their prime registration in the primary care workforce in China. The vast majority of CHC staff participated in CME but there is room for improvement in how CME is organised.

Key words Continuous medical education, Training, Quality of care, Primary care, China

Strengths and limitations

This study surveyed the CME situation of a random sample of 3,580 medical staff in CHCs in mainland China. We focused on doctors and nurses working in CHCs, who are the core of the primary care workforce. Our study provides a useful baseline of the frequency and types of locally-organised CME activities across a large number of CHCs. The main limitation of this study is that we focused on CME activities that were organised by CHCs but arguably those were the most commonly attended by the staff of individual CHCs. It would be valuable to also know how frequently staff participated in CMEs conducted outside of organizations (e.g. by training institutions or self-directed learning). We did not evaluate the quality of CME being delivered nor whether observable health improvements had resulted from CME participation. Other important parameters for CME evaluation to consider would be costs to attend CME, management support, funding/resources, quality of CME instructors/coaches. Although we surveyed over 3,500 medial staff from a random sample of CHCs in China, they may not be representative of all CHC staff in China. Moreover, social desirability might constitute a threat in such self-reported surveys especially if participation in the survey was encouraged by the supervisors. These could be the

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subject of future research through in-depth qualitative interviews of CHC staff and focused evaluations of CME programs in China.

Introduction

The importance of a strong primary care system based on first contact access and provision of person-focused comprehensive care with continuity and coordination, is widely accepted.[1-6] Despite a strong primary care system being repeatedly shown to be an effective approach at reducing health inequity and achieving universal health coverage,[2] many countries have yet to develop a robust primary healthcare system. Instead, primary care services are often characterized by inadequate resources and facilities, lack of appropriate training for their medical staff, variable quality in delivery of care and fragmented care.[7] In China, these problems were further compounded by economic and healthcare reforms in the 1980s which involved fiscal decentralization, commercialization of medical services, and underfunding of the public healthcare sector. These turned a generation of health professionals and the general public to rely heavily on high-tech diagnostics, expensive drugs and specialist procedures.[8,9] These factors reinforced unrealistic patient expectations focused on specialist diagnostic aids and procedures, while alienating cost-efficient primary care that would better suit the nation's health needs.[10]

In 2009, the Chinese government responded to these problems and committed themselves to re-establishing primary healthcare.[11] According to Health & Family Planning Commission, expenditure on primary care has reached USD17.74 billion (1USD=¥6.20) and accounted for approximately 30% of the public spending on health in 2014.[12] In fewer than ten years, the Chinese Government has succeeded in establishing a primary care infrastructure composed mainly of rural township centres,

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village clinics and community health centres (CHCs) in cities. By 2014, 8,669 CHCs were established, employing over 300,000 health professionals, the great majority of which were from the established rural practices. However, the historical image of 'barefoot doctors' who had worked in rural regions since the 1950s, criticism of the healthcare system by end-users, and negative publicity by the media have all led to a breakdown of trust between patients and health professionals, including in the newly-revamped primary care system.[9] This problem appears particularly pronounced in the cities where patients have greater choice and easier access to hospitals. One of the major problem is that CHC health professionals (doctors and nurses included) are regarded as poorly qualified and trained, and CHCs are poorly resourced, providing "low tech" facilities.[13]

In the past, medical courses were offered by a variety of colleges, vocational training schools and universities, ranging from 2-8 years of training. Graduates of these courses would have to sit and pass board examinations to be registered for their chosen specialties. Although shorter courses are still available to train the rural workforce, five-year undergraduate programs based at the university are now the norm to enter into vocational training. Nonetheless, general practice is a relatively new clinical discipline in China and there are currently few general practice departments in medical schools.[14] Hence, the exposure to general practice and primary care teaching at the undergraduate level is minimal and the discipline has a low status amongst other clinical disciplines.

At the vocational training level, the emphasis has been on implementing the new policy of establishing primary care in a very short time span through re-orientation of specialists to general practice, initially by "on-the-job training" and later replaced by "job-transfer" training. "Job-transfer training" is a one-year long programme aimed at

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the less qualified doctors currently working at CHCs or those who have not undergone "on-the-job training" which entailed a series of short courses to enhance their theoretical knowledge of general practice and practical clinical skills through a combination of lectures, hospital rotations and community-based placements. Since 2011 this has been replaced by a three-year structured program with 2.5 years in hospital rotations followed by six months in the community.

Continuous medical education (CME) aimed at maintaining, developing and enhancing medical providers' professional knowledge, skills and interpersonal capacity to keep abreast of professional lives, is an essential element to maintain quality of care in this new system[15,16] and CME is compulsory for ongoing registration in China. These CHC staff are required to participate in CME organised by training institutions at national, provincial, municipal, district and center level, and they have to fulfil at least 25 credits of approved CME every year which is accredited every two years. According to the "Twelfth 5-year plan",[17] 100% of senior, 95% of mid-grade; and 80% of junior health professionals at provincial and city levels should achieve the required CME targets over two years. For staff working in western and peripheral regions of China, these targets were reduced to 95%, 80% and 70% respectively to reflect the phased development of primary care in these large and dispersed regions of the country. The hierarchy of the titles can only be achieved after passing the qualifying examination and fulfilling a number of stringent criteria including CME requirements, written examinations and publication of research manuscripts. This study aimed to evaluate the current organization and manpower of CHCs in China, as well as the training (especially the content and delivery of CME) of health professionals within primary care in China.

Methods

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A nationwide survey using a stratified randomized sample was conducted amongst CHC medical professionals between September and December 2015. China was divided into three administrative regions: central, eastern and western. These regional differentiation are based on geographic, economical and medical jurisdiction. Two provinces were randomly selected from each region; and from these, the capital city and two district-level cities were selected at random. In addition, two of the four major municipalities (Beijing, Shanghai, Chongqing and Tianjin) were also selected at random and included in the sample. In total, twenty cities were chosen from the provinces and municipalities combined. From these, nine CHCs were randomly selected from each city (with an urban-to-suburban ratio of 2:1), giving a total of 180 CHCs. The lead clinicians and all doctors and nurses (excluding traditional Chinese herbalists) with direct patient contact from these selected CHCs were invited to participate in the survey.

The local chairpersons of the General Practitioner Associations of the six selected provinces and two selected municipalities were contacted, whom in turn, contacted the randomly selected CHCs. Training on how to distribute and complete the survey questionnaire was arranged for the coordinators of each province or municipality prior to the study. These coordinators were responsible for tracking and collecting the questionnaires. Collected data was entered and cleaned using EPIDATA 3.1. A data entry team was responsible for data input and appointed personnel for auditing and quality control.

The study consisted of two questionnaires, one for the lead clinicians and another for CHC staff (i.e. doctors and nurses). The former (Appendix 1) covered current clinical set-up, range of services and staff composition, community characteristics and patient demographics; as well as information on CME organized at the clinic. In this survey we asked the lead clinician to use their own records to estimate the median population

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size of the catchment area and number of patient contacts in the past year. In the second survey, we asked the frontline health professionals about their training experience, CME participation and their willingness to conduct certain testing services. CME organized by CHCs was compared with actual participation reported by the CHC staff. These surveys were pilot-tested twice on three CHCs and twenty-five practitioners with modifications made accordingly. Detailed methodology and, availability and use of primary care facilities is reported elsewhere.[18]

Descriptive analyses were conducted for percentages and frequencies of key parameters. These were compared with the National Health Statistics Yearbook[12]. Confidence intervals for the sample proportions were calculated using the Agresti-Coull (adjusted Wald) method. CME content were defined as 'clinical guidelines discussion' (i.e. discussion of new clinical guidelines i.e. proecdures in diagnosis or new drugs in managing a patient with a selected condition common to primary care), 'mangement updates' (i.e. new drugs or procedures that becomes available to the CHC or changes in workflow at the practice), and 'case discussion' (i.e. presentation of a difficult case for group input with supporting evidence form the literature). CME participation and content were broken down according to the three administrative districts which have different requirements for CME participation. Univariate logistic regression was used to explore the staff characteristics as the independent factors (with crude odds ratios (OR) and 95% confidence intervals (CI) calculated) associated with participation of CME by the health professionals after adjusting for gender, medical specialty, years working in the CHC, job title and education level. We also examined factors related to the clinical set up, range of services offered, staff composition, community characteristics and patient demographics (see Appendix 1 for full list of variables from questionnaire) and present in the paper factors which were statistically significant. All variables with p values <0.10 was included in the multivariate model and through backward elimination, we report the final variables

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(with adjusted odds ratios (AOR)) with a p-value less than 0.05 as statistically significant by convention. We adjusted the final model for age, gender, medical specialty, years working in the CHC, job title and education level. Data were analyzed using STATA (StataCorp. 2013. *Stata Statistical Software: Release 13.* College Station, TX: StataCorp LP).

Results

One hundred and forty-nine out of the 189 CHCs contacted provided data on their CHC (79% response rate). Figure 1 shows the distribution of CHCs surveyed in China. The median number of fulltime general practitioners working at CHC was 8 (interquartile range (IQR) 4-14) and fulltime nurses was 13 (IQR 8-12). Of the 4,146 health professionals invited, 1,734 doctors and 1,846 nurses completed the survey giving a response rate of 86%. A very small percentage of them might have double qualifications in medicine and nursing.

The median population size of the catchment area of each CHC was 50,000 people (IQR 30,000 to 96,000) with a migrant population of 11,100 (IQR 5,000-30,000). The median patient contacts per year was 41,100 (IQR 12,000 to 163,600). Table 1 provides the demographics of CHC staff compared with the 2015 National Health Statistics Yearbook.[12] The median age of CHC doctors and nurses were young at 38 and 31 years of age, respectively, with a nurse-to-doctor ratio of 1.6. Women accounted for 61% of the doctors and nearly all the nurses. About half (54.5%) of the doctors had bachelor degrees or above, yet only 10.5% of them had acquired senior titles. Despite the fact that all were practising as general practitioners (GPs), only 47% were actually registered as one. Doctors and nurses had worked for a median of 14 years and 9 years, respectively.

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Table 2 shows the range and frequency of reported on-site CME and CME participation at each CHC. CME activities were held by nearly all CHCs (97.2%), where about two-thirds (67.1%) conducted CME sessions monthly or more frequently. The type of in-house CME activities reported were clinical guidelines discussion (100%), management updates (87.9%) and case discussions (83.6%).

Table 3 shows CME participation for different types of health professionals in the three administrative districts. Despite CME participation being extremely high (ranging between 86% to 100%), those in the central and eastern regions fell short of the targets set by the State. In contrast to what was expected by the government, there was no significant difference of CME participation by GPs in the three administrative regions and CME participation was actually commoner among junior doctors in the western and peripheral regions compared to the central and eastern regions (p=0.036).

Table 4 summarizes the multivariate analysis of health professionals' characteristics with CME participation. Amongst doctors, CME participation was commoner among older doctors (adjusted odds ratios (aOR) 1.04 per year), women (aOR 1.7), those registered as GPs (aOR 3.0) and those with an intermediate or senior job title (aOR 2.2). Amongst nurses, CME participation was commoner among those with bachelor degrees (aOR 2.9), with longer experience working in general practice (aOR 1.1 per year) or with an intermediate or senior job title (aOR 2.2).

Discussion

This large study of China's CHCs examines the current primary care workforce and finds it is predominantly staffed by young female health professionals, with only half of doctors holding a bachelor degree or higher, or registered as a GP. The relatively low nurse-to-doctor ratio may reflect the focus of care on doctor-centred approach in

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the traditional medical model. Indeed the lead physicians reported on average there were 1-2 pharmacists, physiotherapists, laboratory technicians or radiographers but clinical psychologists or medical social workers were uncommon. The ratio was far from the international standard of approximately three nurses per doctors as recommended by World Health Organization (WHO).[19] Evidence exists that an undersupply of nurses could result in inefficient allocation of resources.[20]

For historical reasons, many practicing health professionals at CHCs do not have a bachelor degree.[14] Indeed, our study shows just over half of the doctors and under a third of the nurses working in primary care have a bachelor degree. This may contribute in part to the perception of poor training and poor quality in primary care. The quality of health care should be based upon the quality of the workforce rather than just increasing the sheer quantity of staff as it has been the focus of China's policy on development of primary care thus far. The education level and title seniority through examination are considered important indictors of professional standards and competency. Nurses who have a higher level of education provide better health care and safety for their patients.[21]

In China, due to the short history of primary care development, many senior doctors were previously either public health physicians or specialist who converted to being GPs and were given the task of setting up CHCs. Previously "on-the-job" and now "job-transfer" training is offered to the specialists who have converted to work as GPs before sitting the qualifying examination. In order to attract them to primary care, they are allowed to keep up to three specialties on their registration but in our survey, only 47% of the doctors chose to register general practice as their prime registration. We confirm that the CME participation rates for those registered as GPs are higher than those still registered as a specialist. Further, 97% of staff members with

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intermediate and senior level job titles participated in CME, which accounted for 39% of all CHC health professionals (52% of GPs and 29% of nurses). An advancement in job titles may provide a sense of ownership and autonomy,[9] and thus was identified as an independent factor in the participation of CME in our study.

CME is a requirement for practicing professionals in many countries including China in order to maintain medical knowledge and skills.[22] Doctors who do not participate in CME have lower confidence when making clinical decisions.[21] Although it is encouraging to see nearly all CHC staff had participated in CME, one-third of CHCs organize on-site CME activities once every quarter or even once a year, which is far from satisfactory. A Cochrane review suggests that CME should be accessible within health professionals' own clinical communities.[23] Other forms of CME might include attending professional conferences, research workshops or distance learning courses so long as they have been approved by the postgraduate center in their respective city but the focus of CME undergone by doctors or nurses could be different and there are no fixed rules as how frequent they should attend these activities. Learning objectives must be tailored beyond meeting the staff's CME requirements where each CHC or jointly in a locality should take into account the local context and needs e.g. the local disease pattern and epidemiology, and to provide the necessary training and support to their staff to address the skill-mix to deliver the service.

Arguably, reflective learning, meeting self-defined learning objectives and auditing clinical performance with practitioners expected to demonstrate certain competencies in managing the patients independently, would be more appropriate in quality improvement rather than time-based training.[21] Lack of time and appropriate resources have been reported as obstacles for CME participation in China.[24] Alternatives such as self-directed searches in the medical literature or medical websites, or structured resources on the internet (e.g. BMJ learning) or medical

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journals, exist to meet their learning needs.[25,26] Nonetheless these alternatives are limited by the motivation and skills required to perform these searches effectively as well as the availability and accessibility (including the language barrier) of these resources.

Our study suggests that 97.2% of CHCs hold discussions and learning sessions about treatment protocols and 84.8% on disease updates. If used well, evidence-based medicine can aid health professionals in making the most appropriate therapeutic decisions for individual patients and conditions at the clinical level. However, rapid advancements in therapeutic methods and multiple guidelines from both local and international agencies have made it difficult for health professionals to follow them closely. Primary healthcare staff can learn and incorporate these new updates and guidelines into their clinical practices only when they engage in the dissemination and implementation at the early stage, and have the support of their senior colleagues. Moreover, GPs need to take the opportunities provided by CME to share difficulties when dealing with individual patients and build the team to cope with different professional environments.[27] Significant event audit is a regular and compulsory part of annual appraisal for all doctors in the NHS in the UK.[28]

Our survey found that the current CME participation fell short of the overall 95% standard from the "Twelfth Five Years Plan",[17] where 92% of doctors and 89% of nurses surveyed reported regular CME participation. Contrary to what was believed by the policymakers (as reflected in the targets set), participation rates for doctors from the Western and peripheral region CME not only exceeded the target, but evidently Western and peripheral region doctors of junior title had participated more than their counterparts in the other regions, which suggests such regional differentiation is unnecessary.

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Conclusion

In this study, it shows the high participation rates of CME amongst health professionals in CHCs, if used well, could maintain high standards of practice amongst the primary care workforce in China. CHCs could focus on improving nurses-to-doctor, bachelors-to-non-graduate and title seniority ratios as quality workforce improvements. There are disadvantages to continue to rely on conversion of specialists as a source of primary care worksforce. At the same time, CME programmes should be decentralised and take on various forms to meet the local and individual needs whilst regional CME differentiation is unnecessary.

Conflict of Interest

The authors declare that they have no competing interests to declare.

Ethical Considerations

Ethics Committee approvals from a local board (HKU/HAW IRB: UW15-350) and the World Health Organization Regional Office for the Western Pacific (2016.4.CHN.1.HSI) were obtained.

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Contributorship Statement

William CW Wong designed the study and the questionnaire, and wrote up the report. ShanZhu Zhu led the team and oversaw the implementation, and liaised with different Chinese GP Associations. Jason Ong conducted the data analysis, and drafted the results of the manuscript with William CW Wong. MingHui Peng implemented the study and helped some of the data analysis. Cindy L. K. Lam, Michael R Kidd and Martin Roland advised on the study design and questionnaire, and commented on the reports. SunFang Jiang led the team and oversaw the implementation, led the pilot testing as well as implementation of the study, took part in the discussion and modification of the design and the questionnaire.

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Table 1. Basic characteristics and training of CHC health professionals, compared with the 2015 National Health Statistics Yearbook[12]

Variables	DOCTORS		2015 Yearbook	NURSES		2015 Yearbook
	n/N	% (95% CI)		n/N	% (95% CI)	
Median Age (IQR)		38 (32-46)	-		31 (26-39)	-
Gender						
Female	1,025/ 1675	61.2 (58.8-63.5)	53.2	1,793/ 1803	99.4 (99.0-99.7)	99.4
Education						
Below associate degree	202/ 1724	11.7 (10.2-13.3)	19.1	382/ 1831	20.9 (19.0-22.8)	44.4
Associate degree*	582/ 1724	33.8 (31.5-36.0)	36.9	920/ 1831	50.2 (47.9-52.6)	48.3
Bachelor degree or higher	940/ 1724	54.5 (52.1-56.9)	44.0	529/ 1831	28.9 (26.8-31.0)	10.3
Job title						
Senior	180/ 1711	10.5 (9.1-12.1)	10.5	46/ 1815	2.5 (1.9-3.4)	1.5
Intermediate	705/ 1711	41.2 (38.9-43.6)	41.3	471/ 1815	26.0 (23.9-28.0)	22.2
Junior	683/ 1711	39.9 (37.6-42.3)	41.9	1,158/ 1815	63.8 (61.5-66.0)	66.9
None	143/ 1711	8.4 (7.1-9.8)	6.2	140/ 1815	7.7 (6.5-9.0)	9.4
Registered Speciality						
Integrative Medicine	145/ 1700	8.5 (7.2-10.0)	-	2/ 1834	0.1 (0.0-0.4)	-
General practice	799/ 1700	47.0 (44.6-49.4)	-	85/ 1834	4.6 (3.7-5.7)	-
Other Specialty	454/ 1700	26.7 (24.6-28.9)	-	19/ 1834	1.0 (0.6-1.6)	-
Nurse	23/ 1700	1.4 (0.9-2.0)	-	1712/ 1834	93.3 (92.1-94.4)	-
None	75/ 1700	4.4 (3.5-5.5)	-	30/ 1834	1.6 (1.1-2.3)	-
Other	295/ 1700	17.4 (15.6-19.2)	-	18/ 1834	1.0 (0.6-1.5)	-
Median Years working in above speciality (IQR)	14 (7-23)		-	9 (4-18)		-

* Associate degree refers to 2-years health related sub-degree equivalent to a physician assistant

CI=Confidence interval, IQR = interquartile range

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Table 2. Continuous medical education organised and undertaken by the CHCs.

	n/N	% (95%CI)
CHC offering Continuous Medical Education	140/144	97.2 (93.0-99.2)
Frequency of CME organised at CHCs		
Yearly	16/140	11.4 (7.1-17.9)
Quarterly	25/140	17.9 (12.3-25.1)
Bimonthly	13/140	9.3 (5.4-15.4)
Monthly	77/140	55.0 (46.7-63.0)
Biweekly	15/140	10.7 (6.5-17.0)
Weekly	2/140	1.4 (0.1-5.4)
Staff participating in CME		
Managers	140/140	100 (96.8-100)
Doctors	140/140	100.0 (96.8-100.0)
Nurses	140/140	100.0 (96.8-100.0)
Other medical staff	126/140	90.0 (83.8-94.1)
Types of CME activities		
Clinical guideline discussion	140/140	100 (96.8-100)
Management updates	123/140	87.9 (81.3-92.4)
Case discussions	117/140	83.6 (76.5-88.9)

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Table 3. CME participation for different types of health professionals according to the three administrative districts (as reported by CHC staff, n=3,580)

	CENTRAL		WESTERN & PERIPHERIAL		EASTERN		$\chi 2$	*p-value*
	n/N	**% (95% CI)**	**n/N**	**% (95% CI)**	**n/N**	**% (95% CI)**		
Health professionals	701/786	89.2 (86.8-91.3)	916/1018	90.0 (88.0-91.8)	1519/1655	91.8 (90.4-93.1)	5.04	0.08
Doctors	370/407	90.9 (87.7-93.5)	424/462	91.8 (88.9-94.1)	751/807	93.1 (91.1-94.7)	1.89	0.39
Nurse	331/379	87.3 (83.6-90.5)	492/556	88.5 (85.5-91.0)	768/848	90.6 (88.4-92.4)	3.31	0.19
Job titles								
Intermediate & Senior	270/282	95.7 (92.7-97.8)	280/290	96.9 (93.8-98.3)	764/786	97.2 (95.8-98.2)	1.46	0.48
Junior	399/456	87.5 (84.1-90.4)	525/569	92.3 (89.8-94.3)	681/763	89.3 (86.8-91.4)	6.64	0.036
Education level								
Bachelor & higher	380/442	86.0 (82.4-89.1)	646/731	88.4 (85.8-90.6)	739/829	89.1 (86.8-91.2)	2.83	0.24
Associate degree and below	316/339	93.2 (90.0-95.7)	265/282	94.0 (90.5-96.4)	770/814	94.6 (92.8-96.0)	0.85	0.66
Registered specialty								
GPs	146/151	96.7 (92.3-98.9)	143/143	100 (97.5-100)	464/487	95.0 (73.0-97.0)	5.73	0.057
Specialists	217/246	88.2 (83.5-92.0)	272/308	88.3 (84.2-91.7)	281/316	88.9 (84.9-91.2)	0.087	0.96

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Table 4 Crude and adjusted odds ratios for participation in CME by health professionals

Participation in CME for doctors (n=1587)	Crude OR (95% CI)	p value	Adjusted OR* (95% CI)	p value
Age	1.08 (1.06-1.11)	<0.01	1.04 (1.02-1.07)	<0.01
Female	1.86 (1.24-2.79)	<0.01	1.72 (1.12-2.63)	0.01
Graduate degree or above	1.45 (1.02-2.08)	0.04	-	-
GP specialty	4.24 (2.69-6.67)	<0.01	2.97 (1.83-4.81)	<0.01
Years working in occupation	1.07 (1.04-1.09)	<0.01	-	-
Senior or intermediate job title (junior title as reference)	4.22 (2.74-6.48)	<0.01	2.16 (1.31-3.56)	<0.01
Participation in CME for nurses (n=1683)				
Age	1.09 (1.06-1.11)	<0.01	-	
Graduate degree or above	3.29 (2.10-5.16)	<0.01	2.85 (1.79-4.55)	<0.01
Years working in occupation	1.10 (1.07-1.13)	<0.01	1.08 (1.05-1.11)	<0.01
Senior or intermediate job title (junior title as reference)	1.59 (1.06-2.11)	<0.01	2.16 (1.17-4.00)	0.01

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* Adjusted for age, gender, medical specialty, years working in the CHC, job title and education level

CI = confidence interval, OR = odds ratio

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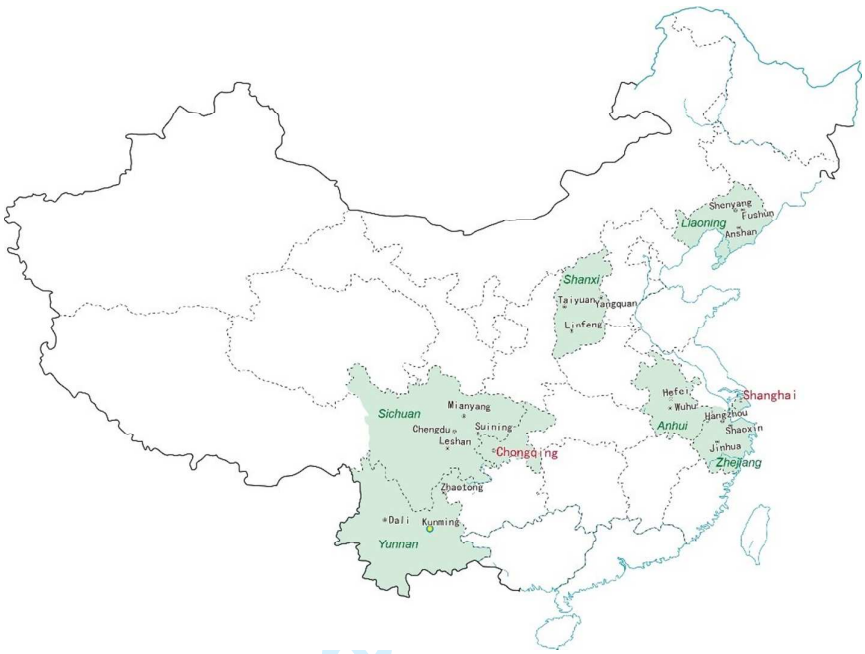

Figure 1 Geographical distribution of the selected cities participated in the survey

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Appendix 1

The factors considered for an association with CME participation were:

- Age (continuous variable)
- Gender (Male, Female)
- Ethnicity (Han, Minority, Other)
- Highest Qualification (Lower than associate degree, associate degree, graduate degree with postgraduate qualifications)
- Registered specialty (Integrative medicine, General practice, Other specialty, Nurse, None)
- Current field of work (Integrative Medicine, General, Other specialty, Nurse, None)
- Years of practice in current field of work (continuous variable)
- Title of technical post (Senior, Intermediate, Junior, None)
- Hours spent on patient care (continuous variable)
- Patients in CHC in the last month (Intravenous drug user, female sex worker, male sex worker, men who have sex with men, transgender people)
- Training in HIV prevention, counselling, diagnosis and care (yes/no)
- Training in common STI prevention counselling, diagnosis and care (yes/no)
- Attitudes towards HIV/STI testing in key populations (strongly disagree/disagree, neither agree or disagree/agree/strongly agree/don't know)
    - I think routine STI testing is an important part of regular healthcare
    - I am concerned about cost and reimbursement for STI testing
    - I am concerned that patients will be offended by being offered routine STI testing
    - I am comfortable discussing routine STI testing with patients
    - Language barriers prevent some patients from receiving routine STI testing
    - Patients often feel like they have to accept routine STI testing
    - Patients receive adequate post-test information for routine STI testing
    - Routine STI testing is voluntary; patients are able to decline screening
    - Patients do not expect to be offered routine STI testing
    - I am concerned that routine STI testing will have a negative effect on patients' opinions about our clinic
    - We have the resources needed to implement STI testing
    - It is difficult to provide the privacy needed for routine STI testing
    - I think routine HIV testing is an important part of regular healthcare
    - I am concerned about cost and reimbursement for HIV testing
    - I am concerned that patients will be offended by being offered routine HIV testing
    - I am comfortable discussing routine HIV testing with patients
    - Language barriers prevent some patients from receiving routine HIV testing
    - Patients often feel like they have to accept routine HIV testing
    - Patients receive adequate pre-test information for routine HIV testing
    - Patients receive adequate post-test information for routine HIV testing
    - Routine HIV testing is voluntary; patients are able to decline screening
    - Patients do not expect to be offered routine HIV testing
    - I am concerned that routine HIV testing will have a negative effect on patients' opinions about our clinic

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- We have the resources needed to implement HIV testing
- It is difficult to provide the privacy needed for routine HIV testing
- I can ask the sexual orientation of the patients
- I can obtain a sexual and reproductive health history from the patients

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Reporting checklist

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Primary Care Workforce and Continuous Medical Education in China: Lessons to learn from a Nationwide Cross-sectional Survey

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Primary Care Workforce and Continuous Medical Education in China: Lessons to learn from a Nationwide Cross-sectional Survey

Short title: Workforce and continuous medical education in primary care in China

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Abstract

Objectives

This study aimed to examine the education and training background of Chinese community health centres (CHC) staff, continuous medical education (CME) and factors affecting participation in CME.

Design

Cross-sectional survey

Setting

Community health centres (CHCs)

Participants

All doctors and nurses working in selected CHCs (excluding those solely practising traditional Chinese Medicine)

Main Outcome Measures

CME recorded by CHCs and self-reported CME participation

Methods

A stratified random sample of CHCs based on geographical distribution and 2:1 urban-suburban ratio was selected covering three major regions of China. Two questionnaires, one for lead clinicians and another for frontline health professionals, were administered between September-December 2015, covering the demographics of clinic staff, staff training and CME activities.

Results

149 lead clinicians (response rate 79%) and, 1,734 doctors and 1,846 nurses completed the survey (response rate 86%). 54.5% of the doctors had a bachelor degree and only 47% were registered as general practitioners (GPs). 10.5% of doctors carried senior titles. Few nurses (4.6%) had training in primary care. 91.6% of doctors and 89.2% of nurses reported participating in CME. CME participation in doctors was more commonly reported by older doctors, females, those who were registered as a GP and those with intermediate or senior job titles. CME participation in nurses was

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commoner among those with a bachelor degree or intermediate/senior job titles, or those with longer working experience in the CHC.

Conclusion

Only half of doctors have bachelor degrees or are registered as GPs as their prime registration in the primary care workforce in China. The vast majority of CHC staff participated in CME but there is room for improvement in how CME is organised.

Key words Continuous medical education, Training, Quality of care, Primary care, China

Strengths and limitations

- We surveyed the CME situation of a random sample of 3,580 medical staff in community health centres (CHCs) in mainland China, focusing on doctors and nurses, who are the core of the primary care workforce.
- Our study provides a useful baseline of the frequency and types of locally-organised CME activities across a large number of CHCs.
- The main limitation of this study was that we focused on CME activities that were organised by CHCs
- We did not evaluate the quality of CME being delivered nor whether observable health improvements had resulted from CME participation.
- Social desirability may be a source of bias especially if participation in the survey was encouraged by the supervisors.

Introduction

The importance of a strong primary care system based on first contact access and provision of person-focused comprehensive care with continuity and coordination, is widely accepted.[1-6] Despite a strong primary care system being repeatedly shown to

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be an effective approach at reducing health inequity and achieving universal health coverage,[2] many countries have yet to develop a robust primary healthcare system. Instead, primary care services are often characterized by inadequate resources and facilities, lack of appropriate training for their medical staff, variable quality in delivery of care and fragmented care.[7] In China, these problems were further compounded by economic and healthcare reforms in the 1980s which involved fiscal decentralization, commercialization of medical services, and underfunding of the public healthcare sector. These turned a generation of health professionals and the general public to rely heavily on high-tech diagnostics, expensive drugs and specialist procedures.[8,9] These factors reinforced unrealistic patient expectations focused on specialist diagnostic aids and procedures, while alienating cost-efficient primary care that would better suit the nation's health needs.[10]

In 2009, the Chinese government responded to these problems and committed themselves to re-establishing primary healthcare.[11] According to Health & Family Planning Commission, expenditure on primary care has reached USD17.74 billion (1USD=¥6.20) and accounted for approximately 30% of the public spending on health in 2014.[12] In fewer than ten years, the Chinese Government has succeeded in establishing a primary care infrastructure composed mainly of rural township centres, village clinics and community health centres (CHCs) in cities. By 2014, 8,669 CHCs were established, employing over 300,000 health professionals, the great majority of which were from the established rural practices. However, the historical image of 'barefoot doctors' who had worked in rural regions since the 1950s, criticism of the healthcare system by end-users, and negative publicity by the media have all led to a breakdown of trust between patients and health professionals, including in the newly-revamped primary care system.[9] This problem appears particularly pronounced in the cities where patients have greater choice and easier access to hospitals. One of the major problem is that CHC health professionals (doctors and nurses included) are

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regarded as poorly qualified and trained, and CHCs are poorly resourced, providing "low tech" facilities.[13]

In the past, medical courses were offered by a variety of colleges, vocational training schools and universities, ranging from 2-8 years of training. Graduates of these courses would have to sit and pass board examinations to be registered for their chosen specialties. Although shorter courses are still available to train the rural workforce, five-year undergraduate programs based at the university are now the norm to enter into vocational training. Nonetheless, general practice is a relatively new clinical discipline in China and there are currently few general practice departments in medical schools.[14] Hence, the exposure to general practice and primary care teaching at the undergraduate level is minimal and the discipline has a low status amongst other clinical disciplines.

At the vocational training level, the emphasis has been on implementing the new policy of establishing primary care in a very short time span through re-orientation of specialists to general practice, initially by "on-the-job training" and later replaced by "job-transfer" training. "Job-transfer training" is a one-year long programme aimed at the less qualified doctors currently working at CHCs or those who have not undergone "on-the-job training" which entailed a series of short courses to enhance their theoretical knowledge of general practice and practical clinical skills through a combination of lectures, hospital rotations and community-based placements. Since 2011 this has been replaced by a three-year structured program with 2.5 years in hospital rotations followed by six months in the community.

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Continuous medical education (CME) aimed at maintaining, developing and enhancing medical providers' professional knowledge, skills and interpersonal capacity to keep abreast of professional lives, is an essential element to maintain quality of care in this new system[15,16] and CME is compulsory for ongoing registration in China. These CHC staff are required to participate in CME organised by training institutions at national, provincial, municipal, district and center level, and they have to fulfil at least 25 credits of approved CME every year which is accredited every two years. According to the "Twelfth 5-year plan",[17] 100% of senior, 95% of mid-grade; and 80% of junior health professionals at provincial and city levels should achieve the required CME targets over two years. For staff working in western and peripheral regions of China, these targets were reduced to 95%, 80% and 70% respectively to reflect the phased development of primary care in these large and dispersed regions of the country. The hierarchy of the titles can only be achieved after passing the qualifying examination and fulfilling a number of stringent criteria including CME requirements, written examinations and publication of research manuscripts. This study aimed to evaluate the current organization and manpower of CHCs in China, as well as the training (especially the content and delivery of CME) of health professionals within primary care in China.

Methods

A nationwide survey using a str`atified randomized sample was conducted amongst CHC medical professionals between September and December 2015. China was divided into three administrative regions: central, eastern and western. These regional differentiation are based on geographic, economical and medical jurisdiction. Two provinces were randomly selected from each region; and from these, the capital city and two district-level cities were selected at random. In addition, two of the four major municipalities (Beijing, Shanghai, Chongqing and Tianjin) were also selected at random and included in the sample. In total, twenty cities were chosen from the provinces and municipalities combined. From these, nine CHCs were randomly

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selected from each city (with an urban-to-suburban ratio of 2:1), giving a total of 180 CHCs. The lead clinicians and all doctors and nurses (excluding traditional Chinese herbalists) with direct patient contact from these selected CHCs were invited to participate in the survey.

The local chairpersons of the General Practitioner Associations of the six selected provinces and two selected municipalities were contacted, whom in turn, contacted the randomly selected CHCs. Training on how to distribute and complete the survey questionnaire was arranged for the coordinators of each province or municipality prior to the study. These coordinators were responsible for tracking and collecting the questionnaires. Collected data was entered and cleaned using EPIDATA 3.1. A data entry team was responsible for data input and appointed personnel for auditing and quality control.

The study consisted of two questionnaires, one for the lead clinicians and another for CHC staff (i.e. doctors and nurses). The former (Appendix 1) covered current clinical set-up, range of services and staff composition, community characteristics and patient demographics; as well as information on CME organized at the clinic. In this survey we asked the lead clinician to use their own records to estimate the median population size of the catchment area and number of patient contacts in the past year. In the second survey, we asked the frontline health professionals about their training experience, CME participation and their willingness to conduct certain testing services. CME organized by CHCs was compared with actual participation reported by the CHC staff. These surveys were pilot-tested twice on three CHCs and twenty-five practitioners with modifications made accordingly. Detailed methodology and, availability and use of primary care facilities is reported elsewhere.[18]

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Descriptive analyses were conducted for percentages and frequencies of key parameters. These were compared with the National Health Statistics Yearbook[12]. Confidence intervals for the sample proportions were calculated using the Agresti-Coull (adjusted Wald) method. CME content were defined as 'clinical guidelines discussion' (i.e. discussion of new clinical guidelines i.e. proecdures in diagnosis or new drugs in managing a patient with a selected condition common to primary care), 'mangement updates' (i.e. new drugs or procedures that becomes available to the CHC or changes in workflow at the practice), and 'case discussion' (i.e. presentation of a difficult case for group input with supporting evidence form the literature). CME participation and content were broken down according to the three administrative districts which have different requirements for CME participation. Univariate logistic regression was used to explore the staff characteristics as the independent factors (with crude odds ratios (OR) and 95% confidence intervals (CI) calculated) associated with participation of CME by the health professionals after adjusting for gender, medical specialty, years working in the CHC, job title and education level. We also examined factors related to the clinical set up, range of services offered, staff composition, community characteristics and patient demographics (see Appendix 1 for full list of variables from questionnaire) and present in the paper factors which were statistically significant. All variables with p values <0.10 was included in the multivariate model and through backward elimination, we report the final variables (with adjusted odds ratios (AOR)) with a p-value less than 0.05 as statistically significant by convention. We adjusted the final model for age, gender, medical specialty, years working in the CHC, job title and education level. Data were analyzed using STATA (StataCorp. 2013. *Stata Statistical Software: Release 13.* College Station, TX: StataCorp LP).

Results

One hundred and forty-nine out of the 189 CHCs contacted provided data on their CHC (79% response rate). Figure 1 shows the distribution of CHCs surveyed in China.

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The median number of fulltime general practitioners working at CHC was 8 (interquartile range (IQR) 4-14) and fulltime nurses was 13 (IQR 8-12). Of the 4,146 health professionals invited, 1,734 doctors and 1,846 nurses completed the survey giving a response rate of 86%. A very small percentage of them might have double qualifications in medicine and nursing.

The median population size of the catchment area of each CHC was 50,000 people (IQR 30,000 to 96,000) with a migrant population of 11,100 (IQR 5,000-30,000). The median patient contacts per year was 41,100 (IQR 12,000 to 163,600). Table 1 provides the demographics of CHC staff compared with the 2015 National Health Statistics Yearbook.[12] The median age of CHC doctors and nurses were young at 38 and 31 years of age, respectively, with a nurse-to-doctor ratio of 1.6. Women accounted for 61% of the doctors and nearly all the nurses. About half (54.5%) of the doctors had bachelor degrees or above, yet only 10.5% of them had acquired senior titles. Despite the fact that all were practising as general practitioners (GPs), only 47% were actually registered as one. Doctors and nurses had worked for a median of 14 years and 9 years, respectively.

Table 2 shows the range and frequency of reported on-site CME and CME participation at each CHC. CME activities were held by nearly all CHCs (97.2%), where about two-thirds (67.1%) conducted CME sessions monthly or more frequently. The type of in-house CME activities reported were clinical guidelines discussion (100%), management updates (87.9%) and case discussions (83.6%).

Table 3 shows CME participation for different types of health professionals in the three administrative districts. Despite CME participation being extremely high (ranging between 86% to 100%), those in the central and eastern regions fell short of

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the targets set by the State. In contrast to what was expected by the government, there was no significant difference of CME participation by GPs in the three administrative regions and CME participation was actually commoner among junior doctors in the western and peripheral regions compared to the central and eastern regions (p=0.036).

Table 4 summarizes the multivariate analysis of health professionals' characteristics with CME participation. Amongst doctors, CME participation was commoner among older doctors (adjusted odds ratios (aOR) 1.04 per year), women (aOR 1.7), those registered as GPs (aOR 3.0) and those with an intermediate or senior job title (aOR 2.2). Amongst nurses, CME participation was commoner among those with bachelor degrees (aOR 2.9), with longer experience working in general practice (aOR 1.1 per year) or with an intermediate or senior job title (aOR 2.2).

Discussion

This large study of China's CHCs examines the current primary care workforce and finds it is predominantly staffed by young female health professionals, with only half of doctors holding a bachelor degree or higher, or registered as a GP. The relatively low nurse-to-doctor ratio may reflect the focus of care on doctor-centred approach in the traditional medical model. Indeed the lead physicians reported on average there were 1-2 pharmacists, physiotherapists, laboratory technicians or radiographers but clinical psychologists or medical social workers were uncommon. The ratio was far from the international standard of approximately three nurses per doctors as recommended by World Health Organization (WHO).[19] Evidence exists that an undersupply of nurses could result in inefficient allocation of resources.[20]

For historical reasons, many practicing health professionals at CHCs do not have a bachelor degree.[14] Indeed, our study shows just over half of the doctors and under a

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third of the nurses working in primary care have a bachelor degree. This may contribute in part to the perception of poor training and poor quality in primary care. The quality of health care should be based upon the quality of the workforce rather than just increasing the sheer quantity of staff as it has been the focus of China's policy on development of primary care thus far. The education level and title seniority through examination are considered important indictors of professional standards and competency. Nurses who have a higher level of education provide better health care and safety for their patients.[21]

In China, due to the short history of primary care development, many senior doctors were previously either public health physicians or specialist who converted to being GPs and were given the task of setting up CHCs. Previously "on-the-job" and now "job-transfer" training is offered to the specialists who have converted to work as GPs before sitting the qualifying examination. In order to attract them to primary care, they are allowed to keep up to three specialties on their registration but in our survey, only 47% of the doctors chose to register general practice as their prime registration. We confirm that the CME participation rates for those registered as GPs are higher than those still registered as a specialist. Further, 97% of staff members with intermediate and senior level job titles participated in CME, which accounted for 39% of all CHC health professionals (52% of GPs and 29% of nurses). An advancement in job titles may provide a sense of ownership and autonomy,[9] and thus was identified as an independent factor in the participation of CME in our study.

CME is a requirement for practicing professionals in many countries including China in order to maintain medical knowledge and skills.[22] Doctors who do not participate in CME have lower confidence when making clinical decisions.[21] Although it is encouraging to see nearly all CHC staff had participated in CME, one-third of CHCs

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organize on-site CME activities once every quarter or even once a year, which is far from satisfactory. A Cochrane review suggests that CME should be accessible within health professionals' own clinical communities.[23] Other forms of CME might include attending professional conferences, research workshops or distance learning courses so long as they have been approved by the postgraduate center in their respective city but the focus of CME undergone by doctors or nurses could be different and there are no fixed rules as how frequent they should attend these activities. Learning objectives must be tailored beyond meeting the staff's CME requirements where each CHC or jointly in a locality should take into account the local context and needs e.g. the local disease pattern and epidemiology, and to provide the necessary training and support to their staff to address the skill-mix to deliver the service.

Arguably, reflective learning, meeting self-defined learning objectives and auditing clinical performance with practitioners expected to demonstrate certain competencies in managing the patients independently, would be more appropriate in quality improvement rather than time-based training.[21] Lack of time and appropriate resources have been reported as obstacles for CME participation in China.[24] Alternatives such as self-directed searches in the medical literature or medical websites, or structured resources on the internet (e.g. BMJ learning) or medical journals, exist to meet their learning needs.[25,26] Nonetheless these alternatives are limited by the motivation and skills required to perform these searches effectively as well as the availability and accessibility (including the language barrier) of these resources.

Our study suggests that 97.2% of CHCs hold discussions and learning sessions about treatment protocols and 84.8% on disease updates. If used well, evidence-based medicine can aid health professionals in making the most appropriate therapeutic decisions for individual patients and conditions at the clinical level. However, rapid advancements in therapeutic methods and multiple guidelines from both local and

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international agencies have made it difficult for health professionals to follow them closely. Primary healthcare staff can learn and incorporate these new updates and guidelines into their clinical practices only when they engage in the dissemination and implementation at the early stage, and have the support of their senior colleagues. Moreover, GPs need to take the opportunities provided by CME to share difficulties when dealing with individual patients and build the team to cope with different professional environments.[27] Significant event audit is a regular and compulsory part of annual appraisal for all doctors in the NHS in the UK.[28]

Our survey found that the current CME participation fell short of the overall 95% standard from the "Twelfth Five Years Plan",[17] where 92% of doctors and 89% of nurses surveyed reported regular CME participation. Contrary to what was believed by the policymakers (as reflected in the targets set), participation rates for doctors from the Western and peripheral region CME not only exceeded the target, but evidently Western and peripheral region doctors of junior title had participated more than their counterparts in the other regions, which suggests such regional differentiation is unnecessary.

This study should be interpreted in light of some limitations. The main limitation of this study was that we only focused on CME activities that were organised by CHCs but arguably those were the most commonly attended by the staff of individual CHCs. It would be valuable to also know how frequently staff participated in CMEs conducted outside of organizations (e.g. by training institutions or self-directed learning). We did not evaluate the quality of CME being delivered nor whether observable health improvements had resulted from CME participation. Other important parameters for CME evaluation to consider would be costs to attend CME, management support, funding/resources, quality of CME instructors/coaches.

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Although we surveyed over 3,500 medial staff from a random sample of CHCs in China, they may not be representative of all CHC staff in China. Moreover, social desirability may be a source of bias especially if participation in the survey was encouraged by the supervisors. These could be the subject of future research through in-depth qualitative interviews of CHC staff and focused evaluations of CME programs in China.

Conclusion

In this study, it shows the high participation rates of CME amongst health professionals in CHCs, if used well, could maintain high standards of practice amongst the primary care workforce in China. CHCs could focus on improving nurses-to-doctor, bachelors-to-non-graduate and title seniority ratios as quality workforce improvements. There are disadvantages to continue to rely on conversion of specialists as a source of primary care worksforce. At the same time, CME programmes should be decentralised and take on various forms to meet the local and individual needs whilst regional CME differentiation is unnecessary.

Conflict of Interest

The authors declare that they have no competing interests to declare.

Ethical Considerations

Ethics Committee approvals from a local board (HKU/HAW IRB: UW15-350) and the World Health Organization Regional Office for the Western Pacific (2016.4.CHN.1.HSI) were obtained.

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Contributorship Statement

William CW Wong designed the study and the questionnaire, and wrote up the report. ShanZhu Zhu led the team and oversaw the implementation, and liaised with different Chinese GP Associations. Jason Ong conducted the data analysis, and drafted the results of the manuscript with William CW Wong. MingHui Peng implemented the study and helped some of the data analysis. Cindy L. K. Lam, Michael R Kidd and Martin Roland advised on the study design and questionnaire, and commented on the

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reports. SunFang Jiang led the team and oversaw the implementation, led the pilot testing as well as implementation of the study, took part in the discussion and modification of the design and the questionnaire.

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Table 1. Basic characteristics and training of CHC health professionals, compared with the 2015 National Health Statistics Yearbook[12]

Variables	DOCTORS		2015 Yearbook	NURSES		2015 Yearbook
	n/N	% (95% CI)		n/N	% (95% CI)	
Median Age (IQR)		38 (32-46)	-		31 (26-39)	-
Gender						
Female	1,025/ 1675	61.2 (58.8-63.5)	53.2	1,793/ 1803	99.4 (99.0-99.7)	99.4
Education						
Below associate degree	202/ 1724	11.7 (10.2-13.3)	19.1	382/ 1831	20.9 (19.0-22.8)	44.4
Associate degree*	582/ 1724	33.8 (31.5-36.0)	36.9	920/ 1831	50.2 (47.9-52.6)	48.3
Bachelor degree or higher	940/ 1724	54.5 (52.1-56.9)	44.0	529/ 1831	28.9 (26.8-31.0)	10.3
Job title						
Senior	180/ 1711	10.5 (9.1-12.1)	10.5	46/ 1815	2.5 (1.9-3.4)	1.5
Intermediate	705/ 1711	41.2 (38.9-43.6)	41.3	471/ 1815	26.0 (23.9-28.0)	22.2
Junior	683/ 1711	39.9 (37.6-42.3)	41.9	1,158/ 1815	63.8 (61.5-66.0)	66.9
None	143/ 1711	8.4 (7.1-9.8)	6.2	140/ 1815	7.7 (6.5-9.0)	9.4
Registered Speciality						
Integrative Medicine	145/ 1700	8.5 (7.2-10.0)	-	2/ 1834	0.1 (0.0-0.4)	-
General practice	799/ 1700	47.0 (44.6-49.4)	-	85/ 1834	4.6 (3.7-5.7)	-
Other Specialty	454/ 1700	26.7 (24.6-28.9)	-	19/ 1834	1.0 (0.6-1.6)	-
Nurse	23/ 1700	1.4 (0.9-2.0)	-	1712/ 1834	93.3 (92.1-94.4)	-
None	75/ 1700	4.4 (3.5-5.5)	-	30/ 1834	1.6 (1.1-2.3)	-
Other	295/ 1700	17.4 (15.6-19.2)	-	18/ 1834	1.0 (0.6-1.5)	-
Median Years working in above speciality (IQR)	14 (7-23)		-	9 (4-18)		-

* Associate degree refers to 2-years health related sub-degree equivalent to a physician assistant

CI=Confidence interval, IQR = interquartile range

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Table 2. Continuous medical education organised and undertaken by the CHCs.

	n/N	% (95%CI)
CHC offering Continuous Medical Education	140/144	97.2 (93.0-99.2)
Frequency of CME organised at CHCs		
Yearly	16/140	11.4 (7.1-17.9)
Quarterly	25/140	17.9 (12.3-25.1)
Bimonthly	13/140	9.3 (5.4-15.4)
Monthly	77/140	55.0 (46.7-63.0)
Biweekly	15/140	10.7 (6.5-17.0)
Weekly	2/140	1.4 (0.1-5.4)
Staff participating in CME		
Managers	140/140	100 (96.8-100)
Doctors	140/140	100.0 (96.8-100.0)
Nurses	140/140	100.0 (96.8-100.0)
Other medical staff	126/140	90.0 (83.8-94.1)
Types of CME activities		
Clinical guideline discussion	140/140	100 (96.8-100)
Management updates	123/140	87.9 (81.3-92.4)
Case discussions	117/140	83.6 (76.5-88.9)

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Table 3. CME participation for different types of health professionals according to the three administrative districts (as reported by CHC staff, n=3,580)

	CENTRAL		WESTERN & PERIPHERIAL		EASTERN		$\chi 2$	*p-value*
	n/N	**% (95% CI)**	**n/N**	**% (95% CI)**	**n/N**	**% (95% CI)**		
Health professionals	701/786	89.2 (86.8-91.3)	916/1018	90.0 (88.0-91.8)	1519/1655	91.8 (90.4-93.1)	5.04	0.08
Doctors	370/407	90.9 (87.7-93.5)	424/462	91.8 (88.9-94.1)	751/807	93.1 (91.1-94.7)	1.89	0.39
Nurse	331/379	87.3 (83.6-90.5)	492/556	88.5 (85.5-91.0)	768/848	90.6 (88.4-92.4)	3.31	0.19
Job titles								
Intermediate & Senior	270/282	95.7 (92.7-97.8)	280/290	96.9 (93.8-98.3)	764/786	97.2 (95.8-98.2)	1.46	0.48
Junior	399/456	87.5 (84.1-90.4)	525/569	92.3 (89.8-94.3)	681/763	89.3 (86.8-91.4)	6.64	0.036
Education level								
Bachelor & higher	380/442	86.0 (82.4-89.1)	646/731	88.4 (85.8-90.6)	739/829	89.1 (86.8-91.2)	2.83	0.24
Associate degree and below	316/339	93.2 (90.0-95.7)	265/282	94.0 (90.5-96.4)	770/814	94.6 (92.8-96.0)	0.85	0.66
Registered specialty								
GPs	146/151	96.7 (92.3-98.9)	143/143	100 (97.5-100)	464/487	95.0 (73.0-97.0)	5.73	0.057
Specialists	217/246	88.2 (83.5-92.0)	272/308	88.3 (84.2-91.7)	281/316	88.9 (84.9-91.2)	0.087	0.96

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Table 4 Crude and adjusted odds ratios for participation in CME by health professionals

Participation in CME for doctors (n=1587)	Crude OR (95% CI)	p value	Adjusted OR* (95% CI)	p value
Age	1.08 (1.06-1.11)	<0.01	1.04 (1.02-1.07)	<0.01
Female	1.86 (1.24-2.79)	<0.01	1.72 (1.12-2.63)	0.01
Graduate degree or above	1.45 (1.02-2.08)	0.04	-	-
GP specialty	4.24 (2.69-6.67)	<0.01	2.97 (1.83-4.81)	<0.01
Years working in occupation	1.07 (1.04-1.09)	<0.01	-	-
Senior or intermediate job title (junior title as reference)	4.22 (2.74-6.48)	<0.01	2.16 (1.31-3.56)	<0.01
Participation in CME for nurses (n=1683)				
Age	1.09 (1.06-1.11)	<0.01	-	
Graduate degree or above	3.29 (2.10-5.16)	<0.01	2.85 (1.79-4.55)	<0.01
Years working in occupation	1.10 (1.07-1.13)	<0.01	1.08 (1.05-1.11)	<0.01
Senior or intermediate job title (junior title as reference)	1.59 (1.06-2.11)	<0.01	2.16 (1.17-4.00)	0.01

* Adjusted for age, gender, medical specialty, years working in the CHC, job title and education level

CI = confidence interval, OR = odds ratio

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Figure 1 Geographical distribution of the selected cities participated in the survey

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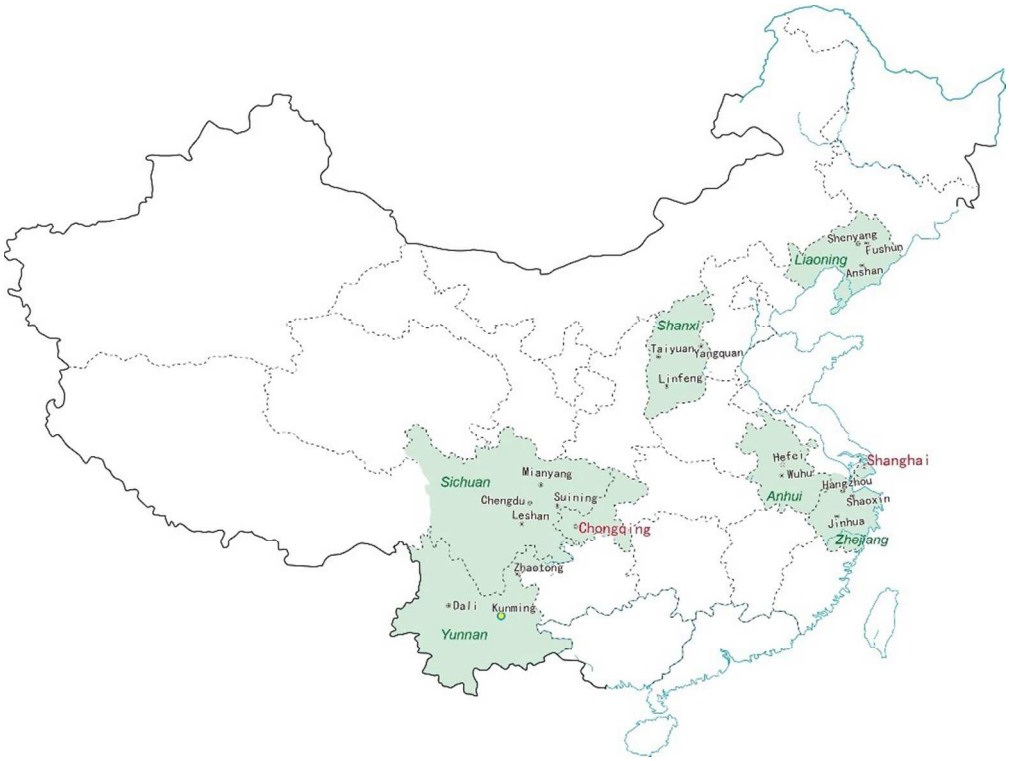

Geographical distribution of the selected cities participated in the survey

120x90mm (220 x 220 DPI)

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Appendix 1

The factors considered for an association with CME participation were:

- Age (continuous variable)
- Gender (Male, Female)
- Ethnicity (Han, Minority, Other)
- Highest Qualification (Lower than associate degree, associate degree, graduate degree with postgraduate qualifications)
- Registered specialty (Integrative medicine, General practice, Other specialty, Nurse, None)
- Current field of work (Integrative Medicine, General, Other specialty, Nurse, None)
- Years of practice in current field of work (continuous variable)
- Title of technical post (Senior, Intermediate, Junior, None)
- Hours spent on patient care (continuous variable)
- Patients in CHC in the last month (Intravenous drug user, female sex worker, male sex worker, men who have sex with men, transgender people)
- Training in HIV prevention, counselling, diagnosis and care (yes/no)
- Training in common STI prevention counselling, diagnosis and care (yes/no)
- Attitudes towards HIV/STI testing in key populations (strongly disagree/disagree, neither agree or disagree/agree/strongly agree/don't know)
    - I think routine STI testing is an important part of regular healthcare
    - I am concerned about cost and reimbursement for STI testing
    - I am concerned that patients will be offended by being offered routine STI testing
    - I am comfortable discussing routine STI testing with patients
    - Language barriers prevent some patients from receiving routine STI testing
    - Patients often feel like they have to accept routine STI testing
    - Patients receive adequate post-test information for routine STI testing
    - Routine STI testing is voluntary; patients are able to decline screening
    - Patients do not expect to be offered routine STI testing
    - I am concerned that routine STI testing will have a negative effect on patients' opinions about our clinic
    - We have the resources needed to implement STI testing
    - It is difficult to provide the privacy needed for routine STI testing
    - I think routine HIV testing is an important part of regular healthcare
    - I am concerned about cost and reimbursement for HIV testing
    - I am concerned that patients will be offended by being offered routine HIV testing
    - I am comfortable discussing routine HIV testing with patients
    - Language barriers prevent some patients from receiving routine HIV testing
    - Patients often feel like they have to accept routine HIV testing
    - Patients receive adequate pre-test information for routine HIV testing
    - Patients receive adequate post-test information for routine HIV testing
    - Routine HIV testing is voluntary; patients are able to decline screening
    - Patients do not expect to be offered routine HIV testing
    - I am concerned that routine HIV testing will have a negative effect on patients' opinions about our clinic

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- We have the resources needed to implement HIV testing
- It is difficult to provide the privacy needed for routine HIV testing
- I can ask the sexual orientation of the patients
- I can obtain a sexual and reproductive health history from the patients

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STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Page No	Recommendation
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract
	2	(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found
Introduction		
Background/rationale	4	Explain the scientific background and rationale for the investigation being reported
Objectives	6	State specific objectives, including any prespecified hypotheses
Methods		
Study design	7	Present key elements of study design early in the paper
Setting	7	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection
Participants	7-8	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants
Variables	7-8	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
Data sources/ measurement	7-8	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group
Bias	7-9	Describe any efforts to address potential sources of bias
Study size	7	Explain how the study size was arrived at
Quantitative variables	7-8	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods	8	(*a*) Describe all statistical methods, including those used to control for confounding
		(*b*) Describe any methods used to examine subgroups and interactions
		(*c*) Explain how missing data were addressed
		(*d*) If applicable, describe analytical methods taking account of sampling strategy
		(*e*) Describe any sensitivity analyses
Results		
Participants	9	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed
		(b) Give reasons for non-participation at each stage
		(c) Consider use of a flow diagram
Descriptive data	9	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders
		(b) Indicate number of participants with missing data for each variable of interest
Outcome data	9-10	Report numbers of outcome events or summary measures
Main results	10	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included
		(*b*) Report category boundaries when continuous variables were categorized
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses	10	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses

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Discussion		
Key results	10-13	Summarise key results with reference to study objectives
Limitations	14	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
Interpretation	14	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
Generalisability	14	Discuss the generalisability (external validity) of the study results
Other information		
Funding	15	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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